INTERFACE AGE™

COMPUTING FOR HOME AND BUSINESS APPLICATIONS
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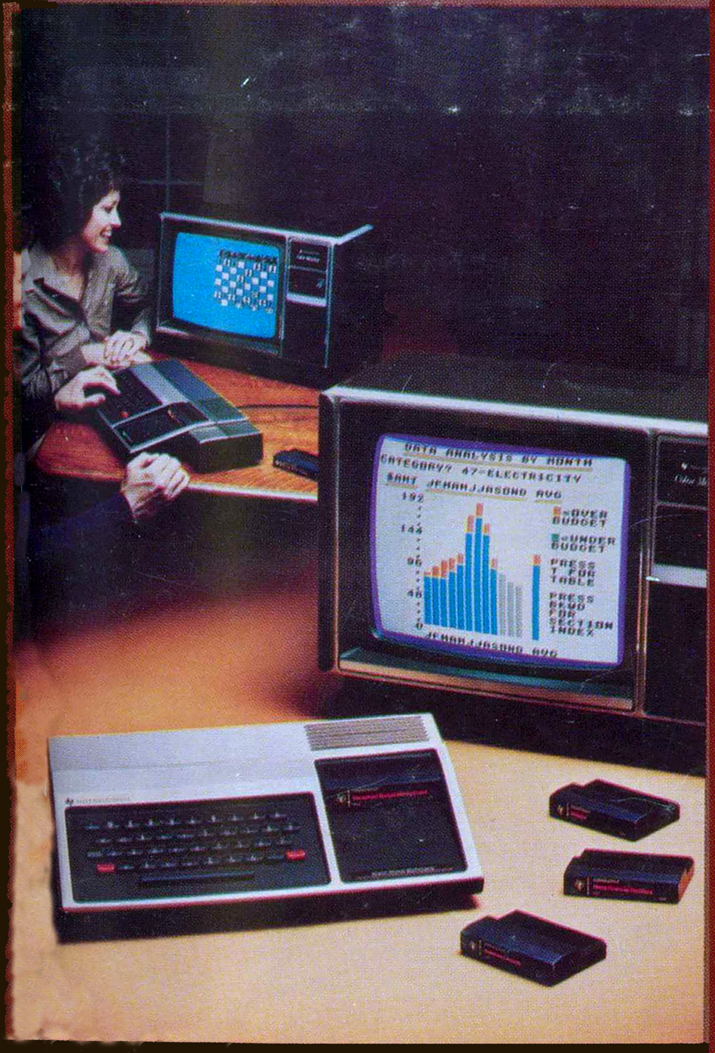
TEXAS INSTRUMENTS, ATARI, MATTEL USHER IN THE NEW AGE OF HOME COMPUTERS


DATA ANALYSIS BY MONTH
CATEGORY? 47-ELECTRICITY
$AMT JFMAMJJASOND AVG
192
144
96
48
0
=OVER BUDGET
=UNDER BUDGET
PRESS T FOR TABLE
PRESS
FOR SECTION INDEX
JFMAMJJASOND AVG

WARNER COMMUNICATIONS INC
ATARI 800
ATARI 810

INTELLIVISION

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mini series
UNIT 6

MICRO AIDS FOR THE HANDICAPPED

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If you have a problem that can be solved by a computer—we have a systems solution.

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Naturally, it's from Cromemco.

This new multi-user system will do all of the tasks you usually associate with much more expensive time-sharing computers. Yet it's priced at an almost unbelievably low figure.

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This new system is based on Cromemco's well-known System Three Computer and our new Multi-User BASIC software package.

Programmers tell us that Cromemco Multi-User BASIC is the best in the field. Here are some of its attractions:

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- **No round-off error in financial work (because our BASIC uses binary-coded decimal rather than binary operation). And we've still been able to make it FAST.**
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VOL. 4, ISSUE 8 AUGUST/SEPTEMBER 1979
SINCE DECEMBER 1975

INTERFACE AGE™

COMPUTING FOR HOME AND BUSINESS APPLICATIONS

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INTERFACE AGE
TEXAS INSTRUMENTS, ATARI, MATTEL USHER IN THE NEW AGE OF HOME COMPUTERS
NTS UNIT 6
MICRO AIDS FOR THE HANDICAPPED

THIS MONTH'S COVER

Cover photos courtesy of Texas Instruments, Atari and Mattel Electronics.

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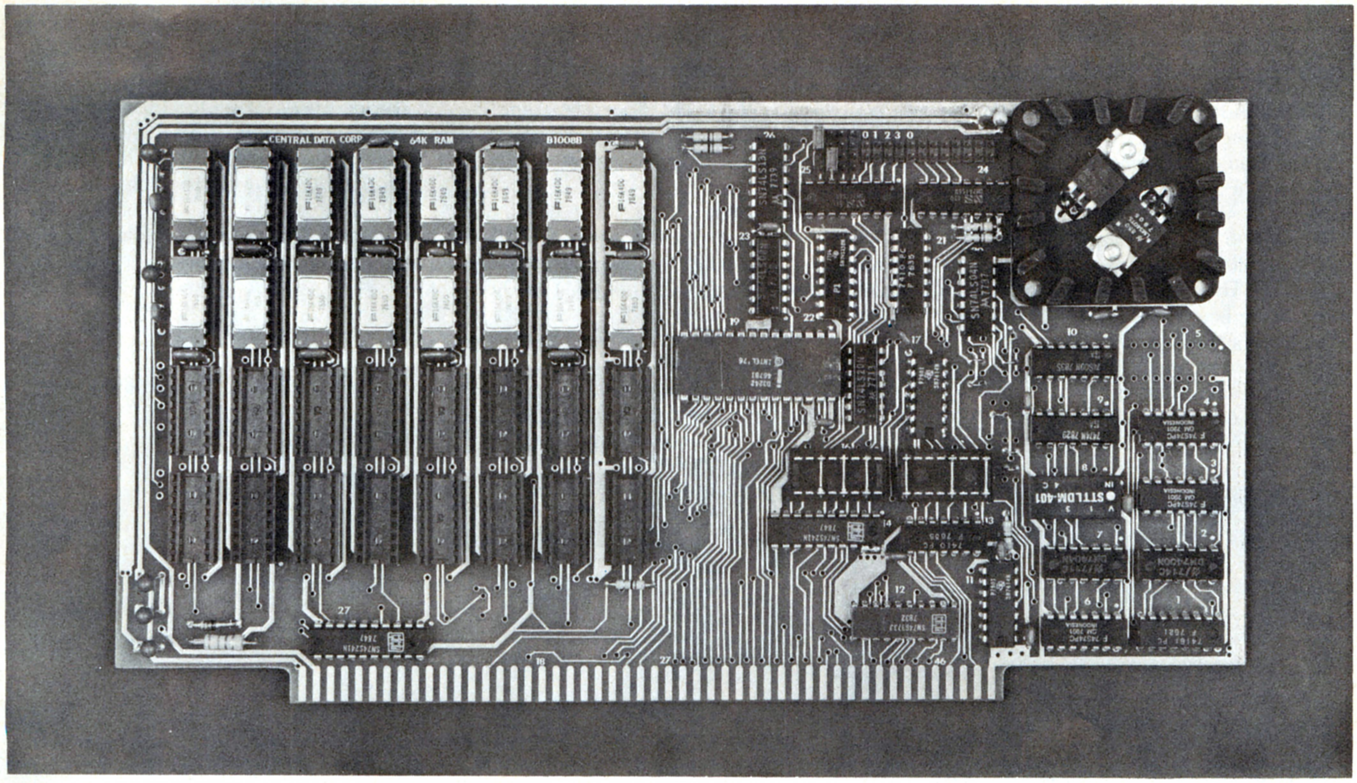

32K Board Pictured Above

New RAM Prices.

From The Dynamic Memory Company.

16K	$249	32K	$375
48K	$500	64K	$625

Ever since we started making these memory boards over a year ago we have continued to lower our prices to stay competitive. Due to your confidence in us, we are again able to lower our prices! Our reliability has been proven by months of superior performance in thousands of installations. Our low-power boards are being used by quality-minded systems manufacturers across the country and overseas.

4MHz boards now available.

After receiving hundreds of requests, our engineering staff has come up with a new version of our board which runs on 4MHz Z-80 systems. It wasn't easy to come up with a high speed board which would operate as reliably as our 450ns version, but after months of careful design and testing, we did it. The price of the 250ns board is $10 per 16K additional.

All of our features remain.

Our boards didn't become great sellers only because of the price. We still offer you our deselect feature which allows our RAM to overlap with any fixed memory areas in your system. Also, the RAM area of our board is fully socketed so that you can expand the board yourself.

Other standard features include: plug selectable addressing on 16K boundaries (shorting plugs are placed over wire-wrap pins to address the board — located on the top of the board for easy changes), S-100 and Z-80 compatability and totally invisible refresh — no wait states.

Fully assembled, tested, and guaranteed.

All of our boards go through a rigorous testing procedure. They are then placed on burn-in running a series of memory tests to detect any other possible faults. After you receive the board, you are backed by us with a one year warrantee.

Low power consumption keeps your computer from "losing its cool."

The total power consumption of our 16K board is typically less than 4 watts (+8V @ 300ma, +16V @ 150ma and −16V @ 20ma). Boards with additional memory typically increase power consumption only 1 watt per 16K!

Standard S-100 Interface.

Our board is designed to interface with any standard S-100 CPU. All of the timing of the board is independent of the processor chip, and the board is set up for different processors by changing two plugs on the board.

Contact your local dealer.

To find out more about our RAM boards, contact your local dealer. If he is unable to help you, call or write us for a fast response. Central Data Corporation, 1207 North Hagan Street, Champaign, IL 61820. (217) 359-8010

Central Data

CIRCLE INQUIRY NO. 7

EDITOR'S NOTEBOOK

Several months ago someone said to me: "Carl, if the microprocessor can be brought into the home in some form other than a computer, it will be commonplace and the public will start viewing the computer as something to be used rather than feared."

The significance of this is becoming clearer every day. That manufacturers are thinking along these lines is very much in evidence, as can be seen from the Consumer Electronics Show and NCC held in June.

Computerized games, toys, calculators that plot biorhythms and general purpose everyman's computers were in abundance at both exhibitions.

PHOTO 1

ASTRO, an astrological computer/calculator, Photo 1, comes from Kosmos International, Inc., 700 Candler Building, Atlanta, GA 30303 and sells for $49.95. It is one of the new entrants to the home market. Kosmos also manufactures biorhythm clocks and calculators.

LEXICON
LK-3000

PHOTO 2

Along the same lines but with a different purpose in mind is the Lexicon LK-3000 (Photo 2) from Lexicon Corporation, 8355 Executive Center Drive, Miami, FL 33166, phone (305) 592-4404. The Lexicon offers a very functional machine idea for the translation of languages. The LK-3000 uses interchangeable cartridges to increase the capability of the machine. For people who travel or need help in translating important material this is a worthwhile item.

A game house called Waddington's House of Games Inc., 2633 Greenleaf Avenue, Elk Grove Village, IL 60007, (312) 640-1776, offers just about every type of game you could hope for, including the Waddington 2001 The Game Machine™, which is four computer games plus a calculator and designed with little folks in the house in mind, Photo 3.

PHOTO 3

THE GAME MACHINE
Waddingtons 2001
THE GAME MACHINE

National Semiconductor, not to be left out in the cold, has introduced the Quizkid Speller, a contribution to the growing game and educational market, Photo 4. The Quizkid sells for $21.95 and is designed to make learning a game. Further information on the Quizkid may be obtained by contacting National Semiconductor, 2900 Semiconductor Drive, Santa Clara, CA 95051, Attn: Ron Evans, phone (408) 737-6189.

PHOTO 4

Those wondering about Parker Brothers need fear no more. They have introduced a complete line of games and toys aimed at the growing electronics toy market. One of the most interesting is called WILDFIRE, Photo 5. It is an electronic pinball game which uses a microcomputer to generate balls of light and the sound effects. The toy also keeps track of scores of up to four players. WILDFIRE sells for $40 and should be available soon in stores carrying Parker Brothers games and toys. If you can't wait, contact Mary Ann Huff, (212) 688-1200.

Wildfire
Wildfire

PHOTO 5

The company that you hear more about each day is Coleco, 16 East 52 Street, New York, NY 10022, (212) 355-5049, Attn: Lois Whitman. They have developed more than their share of electronic games and toys. One that will interest sports buffs is HEAD TO HEAD, an electronic football game, Photo 6. The game provides game action and realistic sounds to keep the player's interest. This may be the game you need while waiting in any long gas lines.

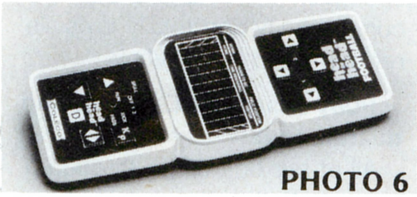

PHOTO 6

From PLAYSKOOL Inc., a Milton Bradley company, 4501 West August Boulevard, Chicago, IL 60651, (312) 276-6700, Attn: Margene Lehman, comes Major Morgan, Photo 7. This little toy is designed for the 3 to 9-year-old crowd and brightens up their day by making music.

PHOTO 7

Now here's the toy for daddy, called Big Trak (Photo 8) from Milton Bradley Company, Springfield, MA 01101, (413) 525-6411, Attn: Pat Mallette. This is that truck or tank you always wanted. Big Trak incorporates TI microcomputer technology to allow for programming of the mighty machine. This means that you can tell Big Trak exactly what you want it to do and when. Big Trak sells for $43 with an extra $13 needed for the optional transport.

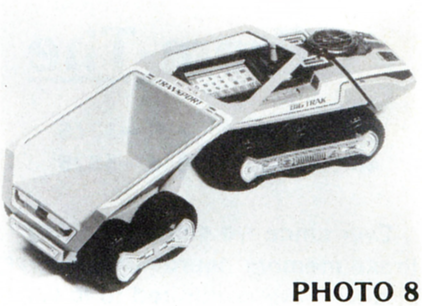

PHOTO 8

Here's something for mom. The NORELCO full feature microwave oven line. Norelco has improved the ovens to make them easier to use and take the mysticism away from cooking a roast under micro control. Photo 9 is the Norelco MCS8100 full feature system that really takes mom out of the kitchen. If cooking is your game, contact Geri Brin care of Norelco Consumer Products Division, North American Philips Corporation, 100 East 42nd Street, New York, NY 10017, (212) 697-3600.

PHOTO 9

To help everybody else out in the house or at least make answering the door a pleasure, L.R. Tanney Assoc., 222 W. Adams Street, Chicago, IL 60606, (312) 263-6231 is distributing the world's first

Both sides now

North Star Announces —

Double Density x 2 Sides = Quad Capacity!

The North Star Horizon now delivers quad capacity by using two-sided recording on our new mini drives! That's 360,000 bytes per diskette! A four drive North Star system accesses over 1.4 megabytes of information on-line! Think of the application flexibility that so much information storage can give you!

North Star has quadrupled the disk capacity of the Horizon computer but prices have increased a modest 15 percent. On a dollar per byte basis, that's a bargain that is hard to beat!

The proven North Star disk controller was originally designed to accommodate the two-sided drives. North Star DOS and BASIC are upgraded to handle the new capacity, yet still run existing programs with little or no change. Of course, single sided diskettes are compatible with the new disk system.

Get both sides now! Quad capacity is available from your North Star dealer.

CIRCLE INQUIRY NO. 40

NorthStar

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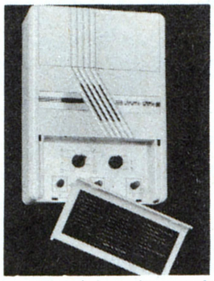


PHOTO 10

electronic door chime. It is programmable to play up to 24 different tunes. From Photo 10 you can see that it is a fairly simple and clean looking device.

ON THE PERSONAL AND BUSINESS COMPUTER SIDE

Obviously with many advances being made in the field of games and things, work was taking place on personal computers and business systems. In this issue we have major features on the TI 99/4 and Atari systems and Mattel's Intellivision. However, it is not always possible to cover everything being offered in one issue.

The most significant announcement at NCC this year was made by Pertec, a company many of you were wondering about. Pertec has been doing its homework and as a result broke ground in two areas.

The first being in storage technology with the introduction of their eight-inch 20 megabyte hard disk system for less than $2,000 in OEM quantities. This disk offers a great deal of capability to the industry backed by a fair amount of knowhow. We plan an in-depth article on this disk for the September issue of INTERFACE AGE.

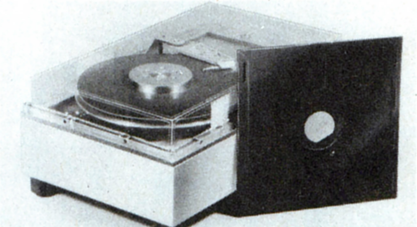


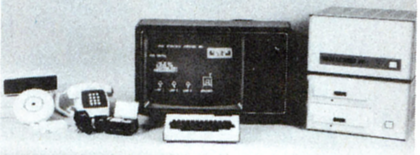
PHOTO 11

The other item of significance was the Pascal Blaiser based on the Western Digital Microengine and executing a version of Pascal based on the University of California at San Diego implementation. Systems Editor Tom Fox is planning a system of the month on the Pascal Blaiser soon, something worth looking forward to. Pertec's Kenn Morris assured me that either writing or calling him will get you as much information as you need. Kenn Morris, Pertec Computer Corporation, Computer Systems Division, 20630 Nordoff Street, Chatsworth, CA 91311, (213) 998-1800.

Along the Pascal lines you will want software. P.S. Inc., 619 N.P. Avenue, Fargo, ND 58102, offers a complete turnkey general business package in Pascal.

Ohio Scientific, 1333 Chillicothe Road, Aurora, OH 44202, (216) 562-3101, has what they call the C8P DF, the home computer of the future, Photo 12. This system provides all the current state of the art enhancements and two 8-inch floppies, giving it a fair amount of storage. The system looks pretty good.

PHOTO 12



APF, Photo 13, has its IMAGINATION MACHINE, that is geared to be a home computer, game machine and basically, like its name says, it's a device to stimulate the imagination. Worth looking into and you can do so by calling Nancy Valent, (216) 464-3636.

PHOTO 13

PASCAL
PERFORMANCE.
PASCAL MICROENGINE

The new Pascal Computer System is driven by a unique 16-bit Pascal MICROENGINE™ — the first microprocessor hardware designed exclusively for direct high-level language execution. ■ The processor is incorporated into a single board computer system, the WD/90, which directly executes Pascal intermediate code generated by the University of California at San Diego (UCSD) Pascal compiler, Release III.0. ■ Since P-code output by the Pascal compiler represents an ideal architecture for a computer executing Pascal programs and since the WD/90 directly executes P-code (no interpreter), these programs execute up to five or more times faster than equivalent systems.

The WD/90 Pascal MICROENGINE™ Computer includes: ■ Pascal MICROENGINE™ processor ■ 64K bytes of RAM Memory ■ Two RS-232 asynchronous/synchronous ports (110-19.2K baud-full duplex) ■ Two 8-bit parallel ports (500 kHz maximum data rate) ■ Floppy disk controller with direct memory access (DMA), switch selectable for: single or double density (IBM format); mini or standard floppy; 1 to 4 drives (same type) ■ Floating point hardware (proposed IEEE standard) ■ Memory Mapped I/O ■ Enclosed power supply ■ Complete UCSD Pascal Operating System (Release III.0)

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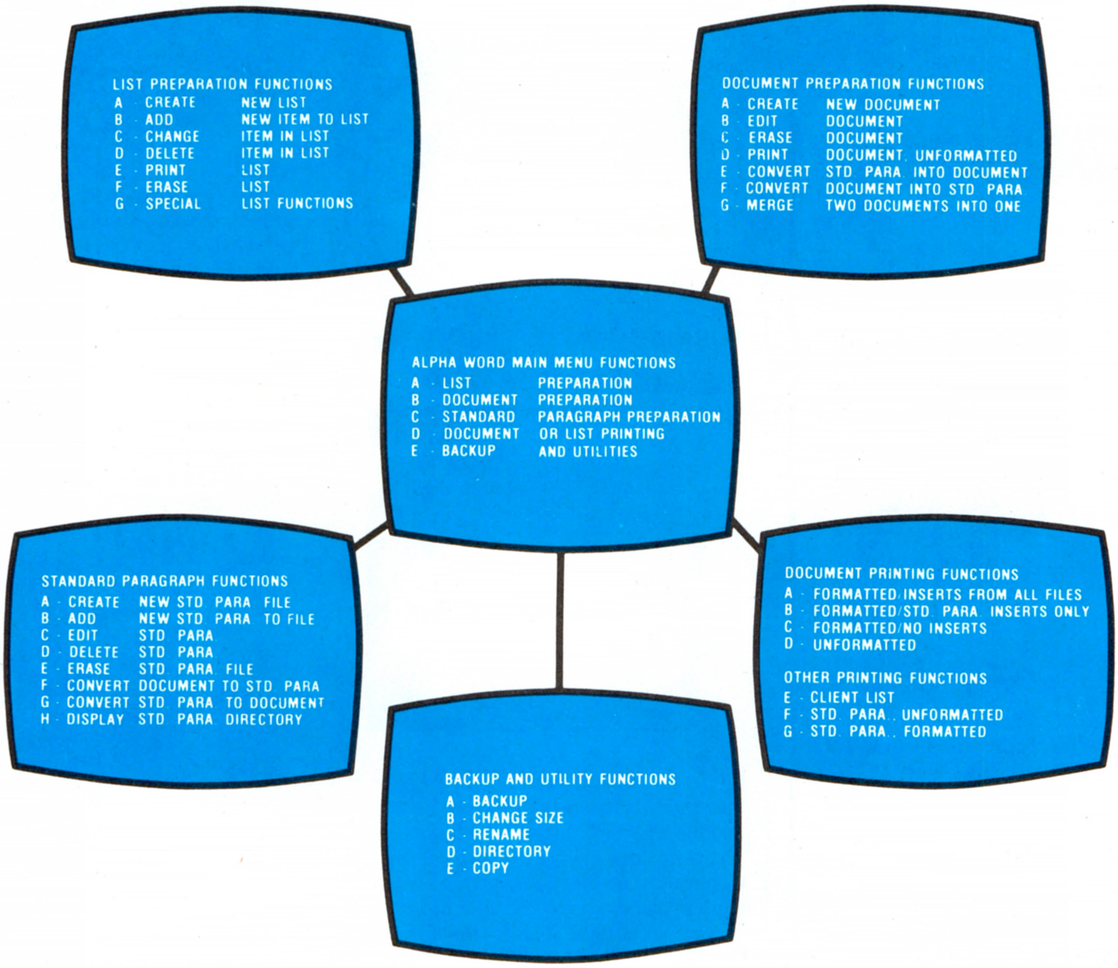
CIRCLE INQUIRY NO. 57

ALPHA WORD™

ALPHA MICRO MENU DRIVEN WORD PROCESSOR


LIST PREPARATION FUNCTIONS
A - CREATE NEW LIST
B - ADD NEW ITEM TO LIST
C - CHANGE ITEM IN LIST
D - DELETE ITEM IN LIST
E - PRINT LIST
F - ERASE LIST
G - SPECIAL LIST FUNCTIONS
DOCUMENT PREPARATION FUNCTIONS
A - CREATE NEW DOCUMENT
B - EDIT DOCUMENT
C - ERASE DOCUMENT
D - PRINT DOCUMENT, UNFORMATTED
E - CONVERT STD. PARA. INTO DOCUMENT
F - CONVERT DOCUMENT INTO STD. PARA.
G - MERGE TWO DOCUMENTS INTO ONE
ALPHA WORD MAIN MENU FUNCTIONS
A - LIST PREPARATION
B - DOCUMENT PREPARATION
C - STANDARD PARAGRAPH PREPARATION
D - DOCUMENT OR LIST PRINTING
E - BACKUP AND UTILITIES
STANDARD PARAGRAPH FUNCTIONS
A - CREATE NEW STD. PARA. FILE
B - ADD NEW STD. PARA. TO FILE
C - EDIT STD. PARA.
D - DELETE STD. PARA.
E - ERASE STD. PARA. FILE
F - CONVERT DOCUMENT TO STD. PARA.
G - CONVERT STD. PARA. TO DOCUMENT
H - DISPLAY STD. PARA. DIRECTORY
DOCUMENT PRINTING FUNCTIONS
A - FORMATTED/INSERTS FROM ALL FILES
B - FORMATTED/STD. PARA. INSERTS ONLY
C - FORMATTED/NO INSERTS
D - UNFORMATTED
OTHER PRINTING FUNCTIONS
E - CLIENT LIST
F - STD. PARA., UNFORMATTED
G - STD. PARA., FORMATTED
BACKUP AND UTILITY FUNCTIONS
A - BACKUP
B - CHANGE SIZE
C - RENAME
D - DIRECTORY
E - COPY

ALPHA WORD is a complete menu driven word processing system, written for the Alpha Micro AM-100 computer.

The Document and Standard Paragraph processors have the main features of Alpha Micro's VUE text processor, including line insert and delete, word insert and delete, page skipping, global search and replace, automatic linefeed at the end of the line, and block move, copy and delete. Your text is interactively stored on disk to ensure system reliability.

The List processor design is a general linked list, with user defined data items and data item keys.

The users manual for ALPHA WORD is written in such a manner that your secretary can easily learn the system in a few hours. This is possible through the use of extensive examples and an easy to read style.

Enhancements appearing in future revisions of ALPHA WORD will be made available to registered users for $30 on floppy disk. Future versions will include (1) Spelling error correction and detection, (2) Automatic index and table of contents generation, (3) Half justification and automatic hyphenations, (4) List search display similar to IBM System 6.

ALPHA WORD software is shipped on an 8 inch floppy disk in standard or AMS format.

ALPHA WORD software is priced at $1500.

Demonstration disks, including users manual, are available for $35.

ALPHA WORD software is available on a hard disk for an additional $100.

Users manuals may be purchased separately for $15 each.

Dealer inquiries invited.

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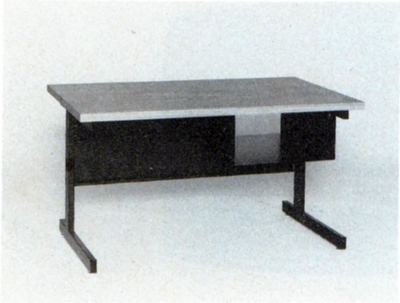
CIRCLE INQUIRY NO. 41

YOUR SYSTEM DESERVES THE VERY BEST. . .



48" wide desk with Micro shelf

48" desk with electronics enclosure and Plexiglas door

Terminal stand, 36" wide, 26" high

. . .Call us for information on how we can help you achieve the very best. . . a wide selection of styles, sizes, and colors is available.

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1441 West 132nd Street
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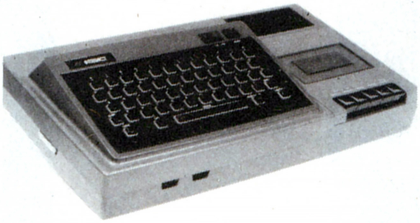
CIRCLE INQUIRY NO. 9

INTERACT ELECTRONICS first showed up, to our knowledge, last January at CES in Las Vegas. At both shows they displayed the Model I personal computer, Photo 14. Interesting in concept and design, only I am not sure who it's for. If this is a computer that excites you, give Janet Blair a call at (312) 263-2500.

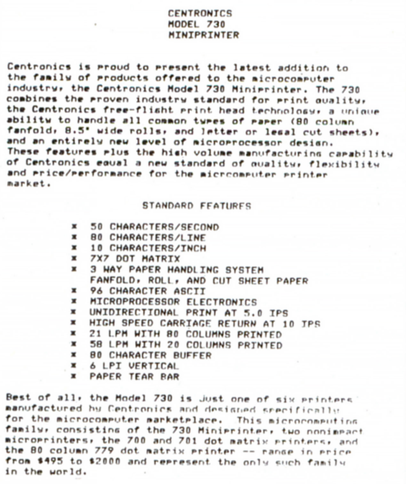
PHOTO 14



TURNING TOWARD PRINTERS

PHOTO 15

They are here — the less-than-$1,000 printers — and Centronics made sure that they are delivering the word better than anyone else. Photo 15 and Figure 1 give you some idea of what the new printers from Centronics are all about. Editor Terry Costlow is planning to tell you more in the November Businessman's Handbook issue.



```
                      CENTRONICS
                      MODEL 730
                      MINIPRINTER

Centronics is proud to present the latest addition to
the family of products offered to the microcomputer
industry, the Centronics Model 730 Miniprinter. The 730
combines the proven industry standard for print quality,
the Centronics free-flight print head technology, a unique
ability to handle all common types of paper (80 column
fanfold, 8.5" wide rolls, and letter or legal cut sheets),
and an entirely new level of microprocessor design.
These features plus the high volume manufacturing capability
of Centronics equal a new standard of quality, flexibility
and price/performance for the micrcomputer printer
market.

                  STANDARD FEATURES

          *  50 CHARACTERS/SECOND
          *  80 CHARACTERS/LINE
          *  10 CHARACTERS/INCH
          *  7X7 DOT MATRIX
          *  3 WAY PAPER HANDLING SYSTEM
             FANFOLD, ROLL, AND CUT SHEET PAPER
          *  96 CHARACTER ASCII
          *  MICROPROCESSOR ELECTRONICS
          *  UNIDIRECTIONAL PRINT AT 5.0 IPS
          *  HIGH SPEED CARRIAGE RETURN AT 10 IPS
          *  21 LPM WITH 80 COLUMNS PRINTED
          *  58 LPM WITH 20 COLUMNS PRINTED
          *  80 CHARACTER BUFFER
          *  6 LPI VERTICAL
          *  PAPER TEAR BAR

Best of all, the Model 730 is just one of six printers
manufactured by Centronics and designed specifically
for the microcomputer marketplace.  This microcomputing
family, consisting of the 730 Miniprinter, two nonimpact
microprinters, the 700 and 701 dot matrix printers, and
the 80 column 779 dot matrix printer -- range in price
from $495 to $2000 and represent the only such family
in the world.
```

Figure 1.

Texas Instruments made some important introductions to the printer, terminal area with the 825 KSR, Photo 16. So did NEC, General Electric and a number of other lesser known firms. The important point is printer technology is changing, and definitely for the better. In his November story, Terry will be exploring some of the things that other companies are doing in this wide-ranging field, and in December the entire INTERFACE AGE staff will be viewing the printer plotter arena.

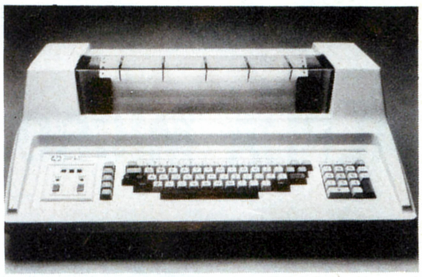


PHOTO 16

KEEP IT CLEAN

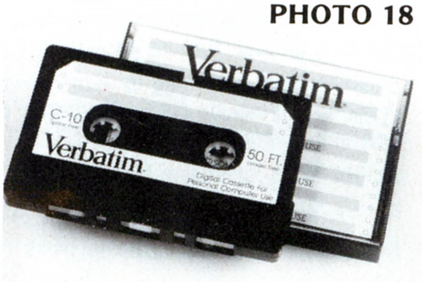
While at the summer CES, I picked up something that we who use tape really need, a cassette tape cleaner, Photo 17. This cleaner works pretty well for ordinary cassette decks but only works for one head on the Phi-deck type systems. I used it on my MECA Alpha I by tricking it into doing a read.

PHOTO 17

The cleaner lists for $5.95 and is worth it. This is something all computer stores should offer their customers. Information regarding this cleaner can be obtained by contacting ALLSOP AUTOMATIC INC., 4201 Meridan Street, Bellingham, WA 98225, (206) 734-9090.

With cassettes on the mind, Verbatim, 323 Soquel Way, Sunnyvale, CA 94086, (408) 245-4400, is offering a premium grade tape (Photo 18) to the personal computer market, and just in time for all these new PCs being introduced.

PHOTO 18



—carl

Structured Systems business software can put a microcomputer to work for you.

DYNABYTE DB8/2

```
                    Gill and F            pany                      PAGE   1
                          Balanc
                    AS OF AUGUST 31, 1978
     ASSETS
       CURRENT ASSETS
         Cash                                  44,760
         Marketable Securities                161,000
         Accounts Receivable                   71,262
         Fees Earned But Not Billed            45,300
         Prepaid Expenses                       6,265
                                            ----------    328,587
       FIXED ASSETS
         Office Furniture                      13,739
         Leasehold Improvements                23,500
         Computer                              11,062
                                            ----------     48,301
       INTANGIBLE ASSETS
         Patents                               13,872
                                            ----------     13,872
     Total ASSETS                                         ----------    390,760
                                                                      ==========

   LIABILITIES AND CAPITAL
     LIABILITIES
       CURRENT LIABILITIES
         Current Part of Long Term Debt         5,000
         Accrued Payroll                        9,242
         Income Taxes Payable                  18,660
         Trade Payables                        24,569
         Accrued Liabilities                      962
                                            ----------     58,433
       LONG TERM LIABILITIES
         Note Payable (Less Current)           20,250
         Retirement Benefits                   51,312
                                            ----------     71,562
     Total LIABILITIES                                    ----------    129,995
     STOCKHOLDER'S EQUITY
       CAPITAL STOCK
         Common Stock $100, 1000 issued       100,000
         Paid in Surplus                          100
         Preferred Stock $25, 800 iss.         20,000
                                            ----------    120,100
       RETAINED EARNINGS
         Retained Earnings, Beginning          21,091
         Net Income Brought Forward           119,574
                                            ----------    140,665
     Total STOCKHOLDER'S EQUITY                           ----------    260,765
                                                                      ----------
   TOTAL LIABILITIES AND CAPITAL
                                                                        390,760
                                                                      ==========

                    Unaudited Statements
                    For Management Use Only
```

SSG's general accounting, data inquiry, mailing, and communications software packages are bringing real computer power to hundreds of businesses right now. They are ready to go to work for your business.

The Honest-To-Business $12,000 Computer*

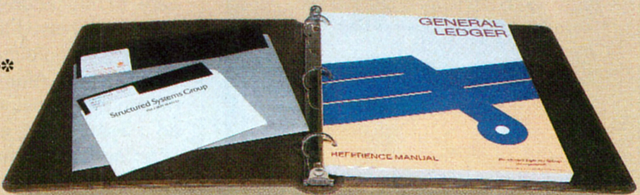
Our software will power DYNABYTE, CROMEMCO, IMSAI, NORTHSTAR, ALTOS, MICROMATION, DIGITAL SYSTEMS, or other Z-80 or 8080 based computers through your General Ledger, Accounts Receivable, and Accounts Payable. And maintain a conversational data-base query system, store and print your mailing list and labels, produce and edit correspondence, address it from your mailing list, and more. The price for a total system—hardware and SSG software—ranges from $8,000 to $14,000.

Real Business Computing

Our Business Software packages are designed to be up and running and working for you in a matter of hours. Without expensive reprogramming, technical staff additions, or costly trial-and-error. Our quality is high, our documentation practically self-instructive. The applications are flexible and extensive, designed to meet and exceed the requirements of most small to medium businesses. Real computer solutions at microcomputer prices.

Some Pleasant Surprises

Your computer retailer can give you a demonstration and literature. You might find a solution just right for your business with "off the shelf" prices and delivery times. Or we will be happy to send you literature direct, including a list of our dealers and compatible hardware. Write us, or call.



The SSG product line includes these outstanding packages:

General Ledger
Accounts Receivable
Accounts Payable
CBASIC-2
LETTERIGHT Letter Writer
NAD Mailing System
QSORT Sorting System
WHATSIT? Data/Query System

Structured Systems Group
INCORPORATED

5204 Claremont   Oakland, California 94618   (415) 547-1567

* Complete prices will vary with equipment and software selected. Required: 8080 or Z-80 based computer running a CP/M or CP/M-compatible disk-based operating system. Your retailer or SSG can advise on specifics. (CP/M is a product of Digital Research.)

Starving for business software for your TRS-80?

Here's food for thought!

Graham-Dorian now has a special department to serve the special needs of TRS-80 owners. And we have four comprehensive business software packages available on disk for any TRS-80 system with 32K or more of memory, 2 to 4 disk drives, and a line printer. They operate with the CP/M™ disk operating system and CBASIC-2.

Each package includes source code on disk and hardcopy source listings in the comprehensive user's manual.

Use your TRS-80 system to its fullest with these sophisticated programs:

- **Inventory Package** — Can be connected with cash register for point of sale inventory control. Number of on-line items limited only by disk space available.
- **Cash Register Package** — Creates daily sales reports containing information on gift certificates, paidouts, overrings, refunds, and how much in each category a salesperson sold.
- **Payroll Package** — Handles 100% of all necessary payroll functions including state income tax tables for your state. Ideally suited for both large and small companies.
- **Apartment Package** — Said one user, "Obviously, this was developed by apartment owners." The package fills virtually all the needs of apartment owners and managers. Ideal for projects with 75 units or more.

$695.00 for any package listed above. Any single package order includes free CBASIC-2.

CBASIC-2 sold separately - $89.95.
CP/M Disk Operating System - $150.00.

Send for detailed packet of information explaining capabilities of each program and sample runs. Or, phone our software technicians.

Attractive dealerships available.

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GDE

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CIRCLE INQUIRY NO. 24

LETTERS TO THE EDITOR

A VERY UNHAPPY CUSTOMER

Dear Editor:

I am writing to request your assistance in securing a satisfactory resolution of a problem I am experiencing with a software company whose ad your magazine first published in the June, 1979 issue. I am specifically referring to SOFTWARE-80, a company whose current address is 18228 Cabrillo Court, Fountain Valley, CA 92708.

In the beginning of January, 1979, I telephoned the company to inquire as to the capabilities of a program they listed as a 'Complete Home Budget', Stock Number 1054. I was looking for a program which would do more than just balance a checkbook and figure the interest on loans. My particular interest was in a program which would function as essentially a home accountant; one which would keep records of all checks written, to whom, for what amounts and by categories which could be used at tax time for a database to prepare my return. Also, I wanted this program to use random access disk files. All of this was explained to the person I reached at the company. I was assured the program would do all that I specified.

I ordered the program the next day and, true to their promise, received it by return mail. I received a disk, no documentation and some general comments on disk use and care. Through trial and error (the program was hardly self-prompting) I discovered at least two errors in each of the two main programs. The sort process was unnecessarily slow; the random filing process space inefficient and the program relatively unsophisticated in using all the capabilities of the TRS-80 Disk BASIC. I am particularly critical of this program as I paid a total of $51.50 for it (not counting the telephone call and subsequent postage). I have gotten more quality in a program for much less.

Two weeks later I wrote the company in care of the address which came with the disk. I expressed the concerns noted above and requested either a refund or a program modification. After not receiving a reply in a month and noticing a different address in an ad, I wrote again, enclosed a copy of the first letter and noted that I had located a printed listing of a program which met my needs. In view of this, I requested a refund only.

One week later I received a terse letter from David Mazar who: 1. denied having received a previous letter — he neglected to mention the change of address; 2. insisted I should have telephoned or written, which I did; 3. implied that it was my fault that the program did not meet my expectations; and 4. stated their firm 'policy' of no refunds but offered my choice of any other programs in their library.

My response was to refuse the exchange offer as the company offers no other program of interest, re-request my refund, and comment on the poor public relation content of the letter.

To date I have received no further response even though I have written two more letters.

I have dealt with ten software companies to date. The record has been programs clearly described and documentation and/or immediate response with the correction of the problem or a prompt refund. By contrast, this company seems to be totally unconcerned about satisfying customers and convey the impression that they are doing the customer a favor by offering programs and taking their money.

While I recognize you imply no responsibility for the accuracy of content and reliability of companies whose ads you accept, I am sure you realize that any subscriber who responds to an ad in your magazine and is justifiably dissatisfied as a result would have to give long consideration to resubscribe if that magazine refused to intervene on the complaint.

Any assistance you can provide in resolving this matter would be most appreciated.

Timothy P. Sukay
Camp Hill, PA

Tim, maybe as a result of seeing your letter printed, a response will be forthcoming.

AN UPDATE

Dear Editor:

Many of the TRS-80 buffs should appreciate R.B. Johnson's "Generating Copies of TRS-80 Machine Language Tapes." In using the program in his article, I did come up with a check sum error each time the copied EDTASM program was loaded. The following additions to the source program will correct the problem:

Add line

```
655   LD    C,A
695   ADD   A,C
815   ADD   A,H
817   LD    C,A
```

The checksum must be formed by the sum of the block starting address LSB and MSB and the data. The above changes to the source program correct the check sum error.

Howard Knippling
Rapid City, SD

WE SERVICE IT OURSELVES

Dear Editor:

An article entitled "Maximixing the DP Effort: The iCOM 4511 10-Megabyte Hard Disk System" in the May 1979 issue contained the statement "Pertec also has available a maintenance contract through Sorbus, a nationwide service organization, to provide preventive and critical maintenance for the units."

This statement is erroneous. The Pertec Computer Corporation Service Division offers contract maintenance on the iCOM 4511 disk system as it does on all products manufactured or marketed by PCC.

The PCC Service Division provides responsive, effective maintenance services. In the case of the 4511, maintenance may be offered by the dealer where he has the capability. Users may also avail themselves of a service contract provided by PCC Service Division through the dealer or direct from PCC.

George Harmon, V.P. & Gen. Mgr.
Pertec Computer Corp.
Los Angeles, CA

UPDATE ON KIM

Dear Editor:

Undoubtedly, many KIM owners such as myself enjoyed the article "6502 Comprehensive Memory Test Program" by Steve Nabers, published in the April, 1979 issue. Steve provides a very valuable tool in troubleshooting the mysterious ailments which crop up occasionally.

I would add one point of clarification for potential users, involving the time taken by the various tests. Timing is given in seconds/k of RAM. For all except TEST5, the elapsed time will be directly proportional to the number of K, whereas TEST5 is proportional to *the square* of the number of K's. Thus, using Steve's timing, total time taken to perform all tests on n K of RAM would be:

$$t(\text{secs}) = n(70n \not- 14.6)$$

For 8K, this is a little over an hour and a quarter, so don't start looking for program bugs, as I did. And if you're tempted to test a contiguous block of 40K, be prepared to spend something like 30 hours waiting for the good news, give or take a couple due to clock differences.

Steve gives plenty of information on how the tests are designed to run, so anyone can change the routine to suit particular systems. It is not Rommable as is, due to the embedded self-modifying piece of code in MAIN where a variable JSR address is used to select the tests.

To Steve Nabers and INTERFACE AGE, keep up the good work!

Ben Doutre
Quebec, Canada

LAMENT OF A COMPUTER WIDOW

Dear Editor:

I hope this finds a place in your magazine; we 'Computer Widows' need an article or two that we can understand and appreciate.

While husbands are out on the golf course,
Out jogging, or mowing the lawn,
My man is down in the basement
With his Superbrain phenomenon.

I envy the wives of those husbands
Who take to the court, field or stream.
The passion for points and for trophies
Would I trade for this monster machine!

He disappears right after supper,
Comes back for a coffee or two,
Then back to converse with his cronie
While sadly I bid him adieu.

It's not that I'm bitter or jealous,
He's under my roof, I agree —
I just have to face and accept it
I married a computer junkie.

They have the best time playing 'Star Wars'
And chess and 3-D Tic Tac Toe,
They speak in their own special language
That basic-ly only they know.

The programs they work out together
To store, relay and expedite,
Are done at a speed quite amazing —
So why does it take him all night?!

Oh, where did I fail and abuse him,
To drive him to TRS-80,
To terminal, disk-drive and keyboard,
To pleasures of 32-K-ty.

I've tried to come up to their level,
But Level-2 Basic, I find
Is more than this memory can handle,
I cannot compete with my mind.

I tempt him with womanly gestures,
Romance but a moment away —
"Just wait till my tape is done loading.
This program I just have to play."

A battle plan forms in my mind now,
I know how and where I will fight.
I'll gouge out the 'i' on the keyboard,
And give the resistors a byte.

I'll take out the chips and I'll eat them,
Put starch in the floppy disk-drive,
I'll blindfold and execute programs
And whatever else I contrive.

How great it will be not to share him,
Not to hear him, in sleep, calculate;
If my strategy fails, I will pack myself up,
And arrive in an IBM crate!

Claire Knippling
Rapid City, SD

HOROSCOPE PROGRAM PROBLEM

Dear Editor:

The Astrological Horoscope program in the April issue has at least two problems in it:

- if I compare line 1020 with line 1045, it is clear it is not possible for the "10th house cusp" to be 21 Cap 54, while having the "4th house cusp" be 21 Can 48; the number of minutes should be the same in both cases, since all that has happened is that 180° has been added to the one to compute the other.
- the function FNU, on line 130, does, indeed, what it is advertised to do; unfortunately, it is called in at least two places (on line 660, and somewhere between line 270 and 370) where the argument is negative, and the result is expected to be positive.

I suggest that there is a question as to whether the sample run given in the article was actually produced by the executing program given. There are other small inconsistencies that suggest that this may not be the case. For instance, line 370 assembles the parts of a variable named ST$ which is used to print the sidereal time, but the sidereal time, as printed in the sample run appears to contain spaces (after the H and after the M), that I cannot find in line 370.

I have made the program work, so I cannot object to the algorithm being untried; my point is that with the kinds of errors I have found, I have a real concern that there may be other errors I have not caught that may have a more serious influence.

Perhaps INTERFACE AGE should require from submitters of programs a statement to the effect that a sample run is in fact generated by the program provided?

Michael Erlewine
Ann Arbor, MI

Mike, we try, and have — up until now — had a 60% actual run of all programs. We now have 100%.

When you set your standards high,

TITAN 10
9R21133
Diablo

Pick A Daisy.

Diablo invented the Daisy Wheel. Which is why today, more people pick one of over 100 different Diablo Daisy Wheels when they want print quality at its finest.

So, the next time you want to set your standards high, pick our daisy and you're sure to look your best.

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CIRCLE INQUIRY NO. 17

"My Shugart followed me home."

TROUT
SMALL BOATS
6 42
Master Fly-Tying Guide

"After working all day with the computer at work, it's a kick to get down to Basic at home. And one thing that makes it more fun is my Shugart minifloppy™. We use Shugart drives at work, so when I bought my own system I made sure it had a minifloppy drive.

"Why? Shugart invented the minifloppy. The guys who designed our system at work tell me that Shugart is the leader in floppy design and has more drives in use than any other manufacturer. If Shugart drives are reliable enough for hard-working business computers, they've got to be a good value for my home system.

"When I'm working on my programs late at night, I can't wait for cassette storage. My minifloppy gives me fast random access and data transfer. The little minidiskettes™ store plenty of data and file easily too.

"I made the right decision when I bought a system with the minifloppy. When you lay out your own hard-earned cash, you want reliability and performance. Do what I did. Get a system with the minifloppy."

If it isn't Shugart, it isn't minifloppy.

Shugart

435 Oakmead Parkway, Sunnyvale, California 94086

See opposite page for list of manufacturers featuring Shugart's minifloppy in their systems.

TM minifloppy is a registered trademark of Shugart Associates

CONSUMER ELECTRONICS A $9.3 BILLION BUSINESS

Major consumer electronics products achieved a growth of nearly 15 percent in 1978, establishing a new record for factory production and imports of $9.3 billion, compared to $8.12 billion in 1977, according to the Electronic Industries Association's Consumer Electronics Group.

These statistics, compiled by EUA/CEG Marketing Services Department, are reported in the "Consumer Electronics 1979 Annual Review," a 52-page publication with data on one of the largest industries manufacturing and marketing in the U.S.

Based on the $9.3 billion volume of factory production and imports, it is estimated that sales to retailers of consumer electronics products passed the $15 billion mark in 1978. Major consumer electronics products included in these statistics are television receivers, separate audio components, phonographs, tape equipment, radios and auto radios.

The "Consumer Electronics 1979 Annual Review" calls attention to the industry's remarkable anti-inflationary record of many years standing. The 1979 Annual Review also comments on the major contribution to energy conservation accomplished by the consumer electronics industry when it made the transition to solid state technology.

COMPUTER CLUB FORMS

The NW PET User's Group is attempting to locate persons in the Oregon/Washington area interested in participating in a local users group.

Interested persons should contact NW PET User's Group, John F. Jones, 2134 NE 45th Avenue, Portland, OR 97213, (503) 281-4908.

HAWAIIAN APPLE CLUB

Honolulu Hawaii now has its own Apple Computer Users Group. H.A.U.S., Honolulu Apple Users Society, supports a newsletter containing the latest up-to-date information concerning the Apple. . .program tips & techniques, listings, reviews, etc.

Monthly meetings are held the first Monday at the Computerland Store in Honolulu. The president is Bob McDowell and Randy Brumback is vice president. They hold weekly sessions on programming, learning BASIC, exchanging information, Hi-Res Graphics, etc. Annual dues are $10 and include the newsletter.

The club is interested in exchanging information and software with other clubs. Contact Bill Mark, 98-1451-A Kaahumanu St., Aiea, HI 96701, (808) 488-2026.

GOVERNMENT SERVICE CONTRACTING STUDY

According to a new study prepared by the Electronic Industries Association's Government Division, service contracting with the federal government appears to have a bright future.

The federal government will contract out for more than $100 billion of commercial and industrial type activities in fiscal year 1980, the study points out. This represents almost one-fifth of the total federal budget for the year.

Government service contracting has moved into a new generation of increased structure and greater manageability, the study states. However, it adds, many instructional and implementational technicalities still have to be corrected.

Contracting-Out, An Overview of the Market and the Issues is available from: Government Div., Electronic Industries Assoc., 2001 Eye St., N.W. Washington, D.C. 20006. Price: $15; $7 for EIA members.

DISCO COMPUTER CONTEST

Eventide Clockworks, Inc. is conducting a non-ideological disco contest. Contestants are to find the unique capabilities of the new Real-Time Spectrum Analyzer which has Computer Intelligence. They are to write a program for the Commodore PET computer and Eventide Real-Time Analyzer which, by studying rhythmic content and frequency distribution, could identify disco music. The program should indicate its findings in some way, either on the PET screen, or by activating a relay to perform some action.

First prize will be either a Real-Time Analyzer, or a 24K BIG MEM. Second through Nth prizes will be Eventide T-shirts for all entrants whose entry shows they have given the problem an appropriate amount of thought and work.

The program must be submitted on a PET cassette along with a printed listing in case of difficulty in reading the tape. The program should be in PET BASIC and should be documented for clarity. The program may not exceed the memory of an 8K PET.

For more information contact Eventide Clockworks, Inc., 256 W. 54th St., New York, NY 10019, (212) 581-9290.

BATTELLE TALKING BOOK AND BRAILLE PROGRAM STUDY

A recent study by Battelle's Columbus Laboratories indicates the majority of patrons who use the Talking Book and Braille Program — supported with funds from the State Library of Ohio — are highly pleased with the service.

The program, used by more than 20,000 blind and physically handicapped persons in Ohio, distributes cassettes, records, and Braille editions of popular magazines and books provided by the Library of Congress through Regional Libraries in Cleveland and Cincinnati.

The Battelle study was aimed at evaluating and providing recommendations for improving the library services. Researchers found that 84% of the patrons surveyed rate the program as excellent or very good.

Battelle recommended maintaining the present structure of two regional libraries serving all Ohio residents. The Regional Libraries take patron requests by mail or phone. The study also evaluated the computer systems supporting the service and found them to be sound.

Look for Shugart drives in personal computer systems made by these companies.

Altos Computer Systems
2378-B Walsh Avenue
Santa Clara, CA 95050

Apple Computer
10260 Bandley Dr.
Cupertino, CA 95014

Digital Microsystems Inc.
(Formerly Digital Systems)
4448 Piedmont Ave.
Oakland, CA 94611

Imsai Mfg. Corporation
14860 Wicks Blvd.
San Leandro, CA 94577

Industrial Micro Systems
633 West Katella, Suite L
Orange, CA 92667

North Star Computer
2547 9th Street
Berkeley, CA 94710

Percom Data
318 Barnes
Garland, TX 75042

Polymorphic Systems
460 Ward Dr.
Santa Barbara, CA 93111

Problem Solver Systems
20834 Lassen Street
Chatsworth, CA 91311

Processor Applications Limited
2801 E. Valley View Avenue
West Covina, CA 91792

SD Sales
3401 W. Kingsley
Garland, TX 75040

Smoke Signal Broadcasting
6304 Yucca
Hollywood, CA 90028

Technico Inc.
9130 Red Branch Road
Columbia, MD 21045

Texas Electronic Instruments
5636 Etheridge
Houston, TX 77087

Thinker Toys
1201 10th Street
Berkeley, CA 94710

Vista Computer Company
2807 Oregon Court
Torrance, CA 90503

Shugart®

See and Copy Tape Data

use TRcopy

WITH YOUR LEVEL II TRS-80*

TRcopy is a cassette tape copying system that lets you SEE what your computer is reading.

COPY ANY CASSETTE TAPE**

With the TRcopy system you can copy any TRS-80 Level II cassette tape whether it is coded in Basic or in machine language. You can also copy data created by programs and you can copy assembler listings.

YOU CAN SEE THE DATA

As the tape is being loaded, you can SEE the actual data byte-for-byte from the beginning to the end of the program. Up to 320 bytes are displayed at one time. ASCII characters are displayed on the first line and hexadecimal code is displayed on the following two lines. Data is displayed exactly as it is input including memory locations and check sums.

IDENTIFY PROGRAMS

With TRcopy you can identify programs on cassette tapes without written documentation because you can SEE the filename. If you forget to label a tape, you can use TRcopy to display the tape contents and identify the cassette.

VERIFY CASSETTE TAPES

With TRcopy you can verify both the original tape and the tape copies. You can make certain that your machine reads the original tape correctly and that it makes byte-for-byte copies. TRcopy also counts as it reads giving you the exact length of the data.

MAKE BACKUPS FOR YOUR PROGRAMS

Now you can make backup copies of your valuable programs. Many times a cassette that you make will load better than one that is mass produced. The original can then be kept as a backup in case the copy is damaged.

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If you are in the software business you can use TRcopy to make tested copies of your programs for sales distribution. TRcopy produces machine language tapes that are more efficient than those produced by the assembler itself.

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With TRcopy you can experiment with the volume and level controls and you can SEE what the computer is reading--even if your computer will not read the data through normal read instructions! In this way it is possible to read and copy faulty tapes by adjusting the volume control until you SEE that the data is input properly.

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CIRCLE INQUIRY NO. 14

the Column

By Arlan Dabling and
Jim Schreier, Associate Editor

A TRS-80 DISK RENUMBERING PROGRAM

Arlan Dabling's TRS-80 Disk Renumbering Program was an early attempt at programming the TRS-80 which has worked well with few revisions.

The TRS-80 Renumbering Program only supports ASCII disk files. An error trap will notify the user of an attempt to renumber a binary file. Enter the program from the listing and debug your entry.

OPERATION NOTES

The first question during execution of the Renumbering Program is "SOURCE FILENAME?". Enter the name of the disk file you wish renumbered. "DESTINATION FILE NAME?" will either be a temporary or the new name for the renumbered file. "NEW STARTING LINE #?" requires the first line needed for renumbering. The entire disk file will be renumbered. Renumbering is not line selectable. "LINE INCREMENT?" may be any whole integer that will not exceed the TRS-80 BASIC maximum line number.

At this point the Disk Renumbering Program will self-execute. Each line needing renumbering will be printed on the terminal. First, a count is made of the lines in the file. An array is set relating the old and new lines. The necessary dimensions are also set at this point. The proper renumbering now occurs.

One of the interesting aspects of Dabling's TRS-80 Disk Renumbering program is that each of the self-executing moves of the program are displayed on the terminal.☐

PROGRAM LISTING

```
1 CLS:PRINT"RENUMBERING PROGRAM FOR TRS-80 DISK
BY ARLAN DABLING - MESA, ARIZONA":
CLEAR50:CLEARMEM-(MEM/4.9)
2 DEFINT I-O:NF=500:O1=1:FORI=1TO5:
READS$(I):LS(I)=LEN(S$(I)):NEXT:PRINT
3 DATA GOTO,ELSE,THEN,GOSUB,"RESUME"
4 PRINT"
SOURCE FILE MUST HAVE BEEN
 SAVED IN ASCII (,A) FORMAT.
SOURCE FILE NAME? ";:
LINEINPUTO$:LINEINPUT
"DESTINATION FILE NAME? ";R$
5 INPUT"NEW STARTING LINE #";
LS:INPUT"LINE INCREMENT";LI
6 CLS:PRINT"COUNTING LINES IN ";
O$:OPEN"I",1,O$:PRINT@64,"# OF LINES -"
7 ONERRORGOTO30:LINEINPUT#1,L$
```

Continued on Page 17

The Logical Choice

International Microcomputers Minicomputers Microprocessors 80 Japan Datacomm

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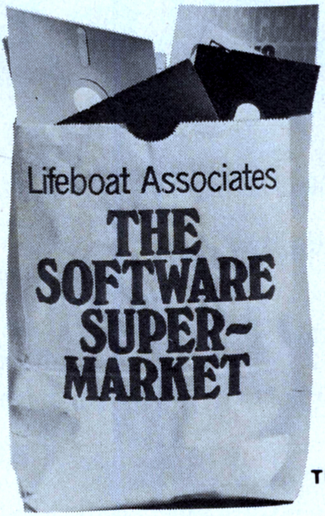

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Continued from Page 14

```
:NL=NL+1:NA=NA+LEN(L$):PRINT@76,USING"####"
;NL:IFEOF(1)THENNA=FRE(L$)*NL/NA:GOTO8:ELSE7
8 CLOSE#1:PRINT:DIM LN(NL),L$(NA):
OPEN"I",1,O$:PRINT"RELATING NEW AND OLD LINE #'S":
FORI=1TONL:INPUT#1,LN(I):IFLN(I)=0THEN30
9 LINEINPUT#1,L$:PRINT@256,USING"
        #####  #####";LS+(I-1)*LI,LN(I):
NEXT:ONERRORGOTO0:CLOSE#1:L$=""
10 PRINT:PRINT"PREPARING TO RENUMBER ";
O$:OPEN"I",1,O$:OPEN"O",2,R$:LN=0
11 PRINT:PRINT"LOADING PROGRAM LINES
 TO BE RENUMBERED.  STANDBY....":
NC=1:NQ=LN:IF(NL-LN)<NA THEN NA=NL-LN
12 L1$=STRING$(255,32):L2$=L1$:ONERRORGOTO29
13 FORI=1TONA:INPUT#1,N%:
LINEINPUT#1,L$(NC):NC=NC+01:NEXT:NC=NC-01
14 ONERRORGOTO0:L1$="":L2$=L1$:CLS:
LN=NC+LN:PRINTNC"PROGRAM LINES LOADED -"
FRE(A$)" MEMORY REMAINS":
FORI=1TONC:L$(I)=L$(I)+" ":NEXT
15 PRINT:PRINT"RENUMBERING PROGRAM LINES":
FORI=1TONC:PRINT@256,USING"#####";
LN(I+NQ);:FORJ=1TO5:KC=1
16 K=INSTR(KC,L$(I),S$(J)):IFK=0THENNEXTJ:
NEXTI:GOTO24:ELSEKC=K+LS(J)
17 C$=MID$(L$(I),KC,1):C%=ASC(C$):
IFC%=32THENKC=KC+1:GOTO17:ELSEKL=0
18 IF(C%>47)AND(C%<58)THENKL=KL+1:KX=KC+KL:
C$=MID$(L$(I),KX,1):C%=ASC(C$):
GOTO18:ELSEIFKL=0THEN16
19 A$=LEFT$(L$(I),KC-1):
N%=VAL(MID$(L$(I),KC,KL)):
B$=MID$(L$(I),KC+KL,255):NX=NL:NS=1
20 IFNS>NXANDN%<>0THEN31ELSENM=INT((NX+NS)/2):
IFN%>LN(NM)THENNS=NM+1:
GOTO20:ELSEIFN%<LN(NM)THENNX=NM-1:GOTO20
21 N%=LS+(NM-1)*LI:IFN%<LSTHENN%=0
22 N$=MID$(STR$(N%),2,8):L$(I)=A$+N$+B$:
PRINT@320,LS+LI*(i+NQ)" "L$(I);STRING$(255,32)
23 K=KC+LEN(N$):KC=K:
IFASC(MID$(L$(I),K,1))=44
THENK=K+1:KC=K:GOTO17:ELSE16
24 CLS:PRINT"SAVING BLOCK OF RENUMBERED LINES":
FORI=1TONC
25 IFRIGHT$(L$(I),1)=" "
THENL$(I)=LEFT$(L$(I),(LEN(L$(I))-1)):GOTO25
26 N%=LS+(I+NQ-1)*LI:N$=MID$(STR$(N%),2,8):
PRINT#2,N$;" ";L$(I):PRINTN$" "L$(I):NEXT:CLOSE#1
27 IFLN<NLTHENOPEN"I",1,O$:
FORI=1TOLN:LINEINPUT#1,L$:NEXT:L$="":
FORI=1TONA:L$(I)="":NEXT:GOTO11:ELSECLOSE#2:CLS
28 PRINT"RENUMBERING OF "O$" COMPLETED.":
PRINT"RENUMBERED PROGRAM IS SAVED AS "R$:END
29 NC=NC-01:RESUME14
30 CLOSE:PRINT"
LOAD ERROR:
 VERIFY THAT "O$" IS SAVED
 IN ASCII (,A) FORMAT.":END
31 CLOSE:PRINT@768,"LINE#"N%"NOT FOUND."
```

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CIRCLE INQUIRY NO. 33

PASCAL PROGRAMMING SEMINAR

Polytechnic Institute of New York and the Institute for Advanced Professional Studies are presenting a five-day seminar for engineers, programmers, and technical managers. The seminar is titled "PASCAL Programming for Mini and Microcomputers." Application examples, lectures, informal sessions with the instructor, as well as individual and group programming sessions are part of the course.

The seminar will be held August 13 through August 17 and again October 22 through October 26 at The Ramada Inn, Woburn, Massachusetts.

Tuition is $600 and includes course notes and text as well as Tuesday evening reception. For additional information contact Prof. Donald French at (617) 964-1412 or write to the Institute for Advanced Professional Studies, One Gateway Ctr., Newton, MA 02158.

INTRODUCTION TO COMPUTER GRAPHICS

The principles and applications of computer graphics will be discussed August 20-24 at Rensselaer Polytechnic Institute.

The course is designed to introduce the attendee to the most important facets of computer graphics in the framework of selected applications of growing importance. It will address topics such as the nature and use of computer graphics, equipment available, cost-benefit trade-offs, and areas and methods of usages. A number of computer-aided design programs of varying degrees of sophistication and from many engineering fields, as well as instructional graphics programs will be available for experimentation.

The fee is $495. For more information contact Richard Teich, Office of Continuing Studies, Rensselaer Polytechnic Institute, Troy, NY 12181, (518) 270-6442.

HAMBURG HAMFEST

Ham Radio enthusiasts are invited to attend the seventh annual Hamfest at the Erie County Fairgrounds. The Ham-O-Rama, as it is known, will be two days long this year, beginning September 14.

For details contact Francis Stengel, Jr., 349 Stony Road, Lancaster, NY 14086.

CANADIAN CONFERENCE

The Government Computer Conference will be held September 11-12 at the Chateau Laurier Hotel in Ottawa. The theme is "Policies, problems and the promise of Canada's information age."

For information contact Janet Glover, Whitsed Publishing Ltd., 2 Bloor St. West, Suite 2504, Toronto, Ontario M4W 3E2.

WESCON/79

Wescon/79 will open a window to electronics technology of the 1980's at its big convention and exhibition in San Francisco, California, September 18-20, 1979. The West's largest high-technology event will focus on product and systems innovations designed to influence industry and home in the new decade.

"Gateway to the Eighties" is the theme and the message will be evident in the more than 780 exhibits and 120 technical and professional presentations.

Professional sessions will be held at the St. Francis and Hyatt on Union Square Hotels. The exhibits will be at Civic Auditorium and Brooks Hall.

Wescon formally gets underway with a preview presentation on Monday, September 17, featuring an all-day marketing conference and the Keynote Address by Dr. John R. Pierce, Professor of Engineering at California Institute of Technology and former Executive Director of the Research-Communications Science Division of Bell Telephone Laboratories. The show ends September 20.

For more information contact Wescon, 999 N. Sepulveda Boulevard, El Segundo, CA 90245.

MINI/MICRO PROGRAMS AIMS AT OEMS, USERS

A 24-session professional program has been outlined for the three-day Mini/Micro Computer Conference and Exposition in Anaheim Convention Center September 25-27. The programs are divided equally between sessions geared towards OEM suppliers and end users.

For more information contact Neil Kelley, Infosystems, Los Altos, CA, (415) 941-1920 or Robert Brown, Hewlett-Packard (DCD), Ft. Collins, CO, (303) 226-3800.

MIMI MONTREAL

The International Society of Mini and Microcomputers is sponsoring a forum for the presentation and discussion of recent advances in the application of mini and microcomputers. The theme of the conference is "The Evolving Role of Minis and Micros within Distributed Processing."

MIMI '79 will be held September 26 through 29 at the Queen Elizabeth Hotel in Montreal. For more information contact the Secretary, MIMI '79 Montreal, P.O. Box 2481, Anaheim, CA 92804.

BOSTON SHOW

Northeast Personal & Business Computer Show will be held at Hynes Auditorium, Prudential Center, Boston, Massachusetts, Friday through Sunday, September 28-30. Show hours Friday and Saturday will be Noon to 10 P.M. and Noon to 6 P.M. on Sunday.

General admission (including seminars and lectures) will be $5. Produced by Northeast Exposition, P.O. Box 678, Brookline Village, MA 02147, (617) 522-4467. Contact them for more information.

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CIRCLE INQUIRY NO. 16

An Open Letter to Anyone
Selling or Building a System
Around a SOL, Apple or TRS-80 Computer

Exidy inc.

Computer Systems Division

Exidy is moving to greatly expanded production facilities. Right now is the time for you to move up to an improved computer system: one built around our Sorcerer computer rather than a SOL, Apple or TRS-80.

The new 48,000 square foot plant (more than double our present size) has the capability of building and testing 200 computers per shift. With more than a year of production under our belts, we are shipping a reliable, well-debugged product.

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SORCERER vs APPLE

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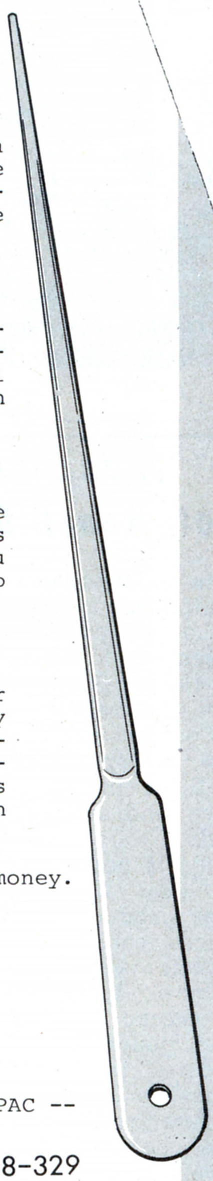

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The independence of Buss is a crucial factor in its significance to users (and prospective users) of Heath Co. computers. Information on new products is presented to Buss readers as it leaks out of Benton Harbor, not held back to suit the marketing plans of the manufacturer. For example, word that Heath Co. was working on the H19 terminal based on the Z80 microprocessor appeared well over a year ago in the February 1978 Buss. News of compatible hardware and software from other venders is also featured.

Buss is not a company-controlled publication, so it can deal with the weaknesses of Heath Co. computer products as well as their strengths. Buss emphasizes candid accounts of owners' experiences with their computers. Their discoveries save subscribers headaches--and money. That's the proven record of over two years of publication. So Buss can guarantee a full refund any time you're not satisfied.

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CIRCLE INQUIRY NO. 26

From the Fountainhead

By Adam Osborne

The Fourth West Coast Computer Fair was a big success. Jim Warren and his associates staged the event at the San Francisco Convention Center; they proved once more that the established computer fairs will continue to draw crowds and exhibitors, while new entries will continue to have a hard time attracting anyone.

Compared with the previous computer fairs, there was more **software** in evidence this time. By next year I expect software will be even more important. Among the more interesting software products on display, I was impressed by the "Word-Star" Text Editing System; it seems to be the first CP/M compatible word processing software package with capabilities that rival commercial word processing equipment. Unfortunately, "Word-Star" was not available for sale at the West Coast Computer Fair; we were informed that it would be available in approximately one month. I hope "one month" does not become a year, as happens all too often. For details on "Word Star" contact:

MicroPro International Corporation
1299 Fourth Street, San Rafael, CA 94901

Another software package with a lot of potential is the Visicalc System offered by:

Software Arts, Inc.
P.O. Box 70 MIT Branch, Cambridge, MA 02139

Currently Visicalc will run on an Apple microcomputer only. It gives you tremendous flexibility handling any type of table data; that is to say, data that can be organized in rows and columns.

This software should be useful to engineers and accountants alike; it will be particularly attractive to business executives who have learned how to deal with computers and would like to have a personal office system to manipulate budgets, or calculate profits.

The tides of fate were evident when looking around the **hardware manufacturers** exhibiting at the West Coast Computer Fair. Many well known names were no longer in evidence; the new rising stars were unlikely contenders a year ago. Vector Graphic was one company I was pleased to see doing remarkably well, since I picked them, in January of 1978, as a future sleeping giant. They have certainly lived up to that favorable billing.

Two hardware manufacturers I pick to do well over the next two years are Digital Microsystems, and Ithaca Audio (now operating under the name Intersystems). These companies manufacture high quality hardware and seem to have very satisfied customer bases.

Photo by Noland Lewis

Adam (right) receives the controversial chips from Terry Ritter.

Terry Ritter of **Motorola** hunted me down at the West Coast Computer Fair to discuss my recent comments regarding the availability of the 6809 microprocessor and 6801 microcomputer; he also wanted to talk about my statement that you should always add two years to any first delivery date that Motorola gives for a new product. Terry wanted to be photographed stuffing 6801 and 6809 chips down my throat.

O.K., Terry, I was off a couple of months in my predicted availability date for the 6809. I was about right on the 6801; and only time will tell if I am right regarding the MC68000. Motorola claims the MC68000 microprocessor will be available in limited quantities this summer. I claim it will be available in limited quantities (working copies, that is) early in 1981. Now we can see who is right.

On the subject of **delays,** one reader of this column approached me with a very interesting question: why have Osborne & Associates been so late with their business program conversion? Unfortunately, I have no good answer, other than to state our policy of never delivering junk to meet a deadline. We will take as long as it takes to debug our programs to the point where they are as error free as testing can determine. If that makes our product late, so be it. However, I promise to try to be more realistic with future delivery dates.

I received a number of interesting **letters from readers** of this column during the past month.

Emil C. Vasquez wrote telling me of a **Spanish BASIC** which he has written for the Pertec microcomputer system. A Spanish BASIC will be received enthusiastically in all Spanish speaking parts of the world. Mr. Vasquez can be reached at:

Microcomputer Center of the Caribbean
P.O. Box 8114
Fernandez Juncos Station
Santurce, Puerto Rico 00910

Mr. David S. Powell of Lexington, Kentucky, wrote a nasty letter to the editor of INTERFACE AGE. Mr. Powell had many very rotten things to say about me in general, and my warnings against kits and using **Selectric typewriters** as I/O devices in particular. I just wonder if Mr. Powell is planning to sell a Selectric typewriter I/O interface as a kit? If he is, and I can kill the project, then I have done the microcomputer industry a great service. Anything I did to kill off the kit business I am proud of. As for Selectric typewriters, they may work for hobbyists, or anyone making very light use of printed output, but history has shown that Selectric typewriters are a very unreliable I/O device. This is a matter of record, it is not a personal opinion.

I heard again from Mr. Douglas DeMers who has displayed unusual perseverance pursuing Technical Design Labs, now known as **Xitan,** seeking a $468 refund for hardware that was never delivered. I planned to warn customers about dealing with Xitan in my February column, but I decided not to, based on assurance from Xitan management that they were getting their act together. They do not seem to have gotten their act together. I urge all Xitan customers to pay for Xitan products only after the product has been received, and checked to be in working order.

Mr. A.N. Gerken of the Southeast Community College in Lincoln, Nebraska, wrote to praise **Objective Design, Inc.** of Tallahassee, Florida, for excellent service and prompt product delivery. It is always pleasant to be able to report good things about anyone.

I received a number of **miscellaneous letters** complaining about individual companies, big and small. No new company has been receiving any pattern of criticism worth identifying, but the general continuing level of complaining letters indicates that problems still exist, and customers should continue to be cautious.

The fact that we are still a gullible lot became clear when the perpetrators of Data Sync re-emerged as "World Power Systems," with multiple page advertising in many microcomputer magazines. I was amazed to see these advertisements, since a casual inspection of the printed circuit cards show them to be improbable mock ups. The World Power Systems people seem to have lured tens of thousands of dollars in prepayments for their products — again. When will readers learn not to send large checks in prepayment for products they have never seen, to companies they have never heard of? And how about magazines taking a little more care before accepting come-on advertising from brand new companies?☐

The views in this column are those of the author and are not necessarily those of the magazine or its staff. Dr. Osborne may be contacted at P.O. Box 2036, Berkeley, CA 94702.

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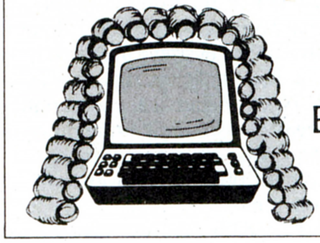

By Leonard Tachner
Attorney-at-Law

TRADEMARKS — PART 2

The selection of an appropriate trademark is primarily a business decision, and only secondarily a legal decision. A trademark should be selected to generate purchaser appeal which tends to enhance sales. However, once a trademark is selected and the business decision is completed, a trademark attorney should be consulted to evaluate the mark from a legal standpoint.

There are two considerations that the trademark counsel makes before rendering an opinion regarding the advisability of using the selected trademark. The first such consideration is the potential risk of liability arising from the possible infringement of someone else's prior trademark rights as discussed in last month's article. Such prior trademark rights can be commonlaw rights which are limited substantially to the area in which the mark has been used, or they may be statutory rights resulting from registration with the state and/or United States Patent and Trademark Office.

In order to ascertain the status of prior trademark usage, the attorney usually conducts a trademark search. Typically, the attorney utilizes trademark search services, some of which use sophisticated computer searching techniques to find similar marks that are relevant because they are spelled in a similar way or are phonetically alike or similar in appearance to the mark in question. Although such trademark searches are by no means infallible, the probability of finding the most relevant marks are enhanced by a search.

Trademark search companies are not licensed to practice law nor are they competent to render an opinion regarding the legal implications of their search. Consequently, they merely forward the results of the search to the attorney who analyzes the various trademarks and tradenames found by the search company and prepares an opinion regarding the legal implications.

The second important legal consideration the attorney makes in his assessment of a selected trademark is the question of the extent to which the trademark may be enforceable and registerable under state and federal laws. In considering this question the attorney will discourage the use of marks that are merely descriptive of the products on which they are used, or in other words, marks that tell the potential customer only what the goods are or how they function or merely describe the characteristics or ingredients of the product.

Marks that are merely descriptive are not registerable and are usually very difficult to assert against alleged infringers unless they have acquired secondary meaning. Secondary meaning means that the trademark has become distinctive and thus is commonly associated in the minds of prospective purchasers with the product on which it is used.

However, because acquisition of such secondary meaning may involve the expenditure of large amounts of advertising dollars and is still conjectural, the attorney usually discourages the use of merely descriptive trademarks unless the client has been using the mark and has already invested substantially in advertising.

The attorney will also discourage the use of marks which are deceptively misdescriptive, a conclusion he will reach if the trademark misrepresents a fact concerning the goods which may materially induce a purchaser's decision to buy the product. On the other hand, if the trademark selected is merely suggestive of the goods or of the function, ingredients, or characteristics of the goods, the attorney will approve the trademark. The distinction between descriptive and suggestive trademarks is a difficult one that should be left to the attorney.

His experience in trademark matters makes it more likely that a client will prevail in his attempt to register the mark or to assert the mark in court if, in his opinion, the mark is suggestive rather than descriptive. One federal court proposed the following test:

> "A term is suggestive if it requires imagination, thought and perception to reach a conclusion as to the nature of the goods. A term is descriptive if it forthwith conveys an immediate idea of ingredients, qualities, or characteristics of the goods."

As an example of the difficulty in determining whether a mark is merely descriptive or suggestive, consider the following table in which the marks on the left have been adjudicated as being merely descriptive (even though some of them are protected because of their secondary meaning), while the marks on the right have been adjudicated to be merely suggestive.

DESCRIPTIVE	**SUGGESTIVE**
BUFFERIN (buffered aspirin)	ARTYPE (cut-out letters for artists)
EBONITE (hard rubber bowling balls)	CHICKEN OF THE SEA (tuna fish)
FASHION KNIT (sweaters)	COMPUGRAPHIC (typesetting equipment)
POCKET BOOK (paperback books)	HULA HOOP (plastic hoops)

Other factors the attorney considers in assessing the assertability of a newly selected trademark are: 1) whether or not the mark is primarily geographically descriptive or is primarily merely a surname, because in both such instances secondary meaning is required before the trademark will be granted registration on the principle register in the U.S. Patent and Trademark Office, 2) whether the mark is non-registerable and also unlikely to be enforceable irrespective of any secondary meaning that may be attached to the mark because it is immoral, deceptive, scandalous or disparages or falsely suggests a connection with persons, institutions, beliefs or national symbols or would bring the same into contempt or disrepute, 3) whether the registration will be refused under the federal law because the mark consists of the flag or code of arms or insignia of the United States, a state, a municipality, or of any foreign nation.

If a mark passes the above test for enforceability and registerability and the search has also shown that there is little or no likelihood of a dispute regarding an alleged infringement of a prior trademark, the trademark attorney usually recommends federal and possibly state registration of the mark as soon as possible.

In order to register a trademark with the U.S. Patent and Trademark Office the applicant must submit the following:

1. A written application which includes his name and address.
2. A drawing or other identification of the trademark.
3. Identification of the goods or services on which the trademark is used.
4. Five specimens or facsimiles of the mark as actually used.
5. The statutory filing fee, which is currently $35.
6. In addition the applicant must state when the trademark was first used on the goods anywhere and also the date of the first use on the goods in interstate commerce.
7. The applicant also must swear under oath or declare under penalty of perjury that he believes himself to be the owner of the trademark and that he believes that no other person has the right to use the trademark in commerce in either identical form or in near resemblance to his trademark.

Registration of a trademark with a state is usually handled by the Secretary of State's Office. State registration requirements are similar except that there is no requirement for use in interstate commerce, only for use within that state. In addition, the statutory fee for registration within a state is lower and, typically, legal fees are less.

Next month the third article on trademarks will treat trademark disputes, infringement litigation and remedies.☐

The material presented in this column is intended for the reader's general information. The author requests that the reader consult professional advisors prior to applying this material to his or her specific situation. Anyone seeking further information may contact the author at the law firm of Fischer and Tachner, 2192 Dupont Drive, Suite 210, Irvine, CA 92715.

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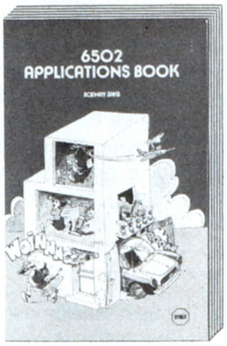

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MICRO MEDICINE

By Wm. V. Weiss, M.D.
Professional Engineer

As a confirmed computer advocate, I generally have nothing but optimism for the future of medical information processing. However, as a physician I find myself constantly playing the role of "devil's advocate" in assessing the value and rationale of many applications that come to my attention. At the moment I have serious reservations about how much interest there really is in the use of microcomputers for health-related educational topics. Although I still feel health professionals will use computers for CAI (continuing medical education applications), I have been disappointed by the poor sales of cassette material with health-related subjects in the computer stores.

I have discussed this with a number of store owners, and my own limited survey indicated few buyers for subjects such as "Nutritional or Weight Control Programs, Biorhythm Programs, etc." There may be a number of explanations: too early to form a valid trend, material not good enough, too few micro owners to create a balanced market.

Most applications in health care to date don't touch the patient except in situations like registration, billing, lab tests, etc. Almost no applications interface with the patient to help educate, treat, or otherwise promote improved health.

Microcomputers will not take hold in medicine until they assist in improving the quality of health care delivery. This is the challenge of the next decade. Whenever I mention this to information processing professionals the first subject that comes to mind is "computerized diagnosis." This requires some perspective.

Many non physicians assume that diagnosis is a mysterious, deductive process similar to a Sherlock Holmes' conclusion. This can certainly be the case in rare situations, but the majority of reasons people go to physicians are fairly simple and do not require the processing power of a medium sized computer. I'm not suggesting the diagnostic process can't be improved, but for the five percent of cases which are puzzling, the computer routine is not practical. If we change our medical model such that medical assistants become the replacement for physicians, then we're in a whole new ball game.

I keep harping on "the use of micros as an educational experience" in health related areas. There is a good reason. Over one-half of routine office visits to the typical primary care professional (General Practitioner, Internist, Gynecologist and Pediatrician) are for informational reasons. One-half the annual mortalities in North America are related to somewhat preventible causes (affected by too little exercise, incorrect diet, smoking, etc.). Perhaps interactive computing has an educational role here.

I recently raised this question with a mixed group of physicians, television and computer professionals, and some creative people. The response was interesting. Although all parties agreed that the possibilities of computer assisted patient instruction might be exciting, it was currently impractical. The coming mixed media techniques make it more practical. But the consensus was that for the present it would be more productive to channel creative energies in this context toward videotape and audiotape applications.

This is occurring with measured success. The real question of course is: Will the patient spend money for an office visit that includes only a technological surrogate, and no face to face, human to human contact?

Most service-oriented activities have been little affected by the computer revolution. The very reason for the success of computers in other areas has been the inherent increased productivity resulting from the computer application. This is not seen in the service sector. I see the computer potentially increasing the quality of care by educational means, but productivity? If the application results in patients feeling even more like "sausages" in a machine than is currently the case then I'd consider it an unmitigated disaster.

In order to generate a greater understanding of the health professional's daily routine, physicians and dentists can be characterized as procedure or non-procedure oriented. For the procedure oriented, computers hold little value, whether the work is dental, or specific medical procedures (surgery, certain diagnostic examinations, etc.). The very rationale for the specialty may be some manual art which requires skill and time. There are on the horizon some computer-enhancing imaging techniques which will improve the quality of data gathered during the procedure, but the patient doesn't experience this as an application of information processing. The non-procedure oriented physician spends most of his time managing information and communicating.

However, the use of data processing in this activity has not been successful, and probably won't be until the "voice input" is the interface between man and machine. Most studies to date are unanimous in confirming that doctors *will not* use present terminals (a few academic research demonstrations notwithstanding) to communicate to a computer. In fact, the principle reasons are: a role-conflict between physician's view of himself as a professional (philosopher-king) and as a computer user (common technician); highly valued interpersonal skills are seen as being exchanged for the simple (and lower status) exercise of data collection; use of computer implies a lack of humanity; physicians also don't like to demonstrate their lack of skill in using keyboard and CRT.☐

Dr. Weiss can be contacted at Biolithics, 600 Sherbourne Street, Suite 803, Toronto, Ontario, Canada M4X 1W4.

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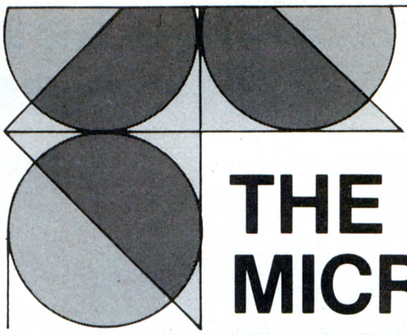


THE MICRO-MATHEMATICIAN

By Dr. Alfred Adler

PROGRAM MORTPAY

I'm sure by now everyone knows there is a land boom in Arizona. Not wanting to be left out, I recently decided to become a land baron myself. I quickly discovered that the second thing I needed (after money) was a short routine that would tell me the amount of the periodic payments. The same routine, of course, is equally useful to anyone purchasing a car, boat, an appliance, or even a computer on time.

Usually one knows the amount of debt, the annual interest rate, the number of payments per year, the number of years over which the debt is amortized, and whether or not a balloon payment (one large final payment to retire the debt) will be required and when. A constant periodic payment will contain little principal and much interest at first, but payment by payment, the interest part will shrink and the principal part will grow. It is not obvious at a glance how to compute the amount of this constant, period payment to fit all of the above constraints. This will be our real task.

It was decided to include other goodies into the program, such as the amount of the balloon payment, the total interest paid, the total amount paid for principal and interest over the lifetime of the debt, and a payment by payment table giving the payment breakdown between principal and interest (called an amortization table).

Let us define the problem as follows. Assume a debt of P dollars, with an interest rate of R% per year. Initial payments of M dollars each are to be made, at the rate of T payments per year calculated over a period of Y years. However, at the end of Z (equal to or less than Y) years the debt will be retired with a single balloon payment of B dollars.

Our first task is to derive an equation for M. The rest is easy. First of all, we cannot use the interest rate in percent directly; we must divide by 100 to reduce it to a multiplying factor. Also we need the interest rate per payment period, not per year. Therefore, let R1 = R/(100*T). Now, the interest part of the first payment will be P*R1, and the principal part will be the periodic payment minus that interest or M−P*R1.

When the second payment comes due the interest part will be less since the principal has already been reduced by M−P*R1. Letting i and p stand for the interest part and the principal part of the payment, respectively, and using a numerical subscript for each successive payment number, let us examine the first few payments.

$$i_1 = P*R1 \qquad p_1 = M - i_1 = M - P*R1$$

$$\begin{aligned} i_2 = (P - p_1)*R1 = i_1 - p_1*R1 \qquad P_2 &= M - i_2 = M - i_1 + p_1*R1 \\ &= M - P*R1 + (M - P*R1)*R1 \\ &= (M - P*R1)*(1 + R1) \end{aligned}$$

$$\begin{aligned} i_3 = (P - p_1 - p_2)*R1 = i_2 - p_2*R1 \quad p_3 &= M - i_3 = M - i_2 + p_2*R1 \\ &= p_2*(1 + R1) \\ &= (M - P*R1)*(1 + R1)^2 \end{aligned}$$

Careful examination of the results so far reveals a definite pattern, from which it becomes obvious that for the mth payment

$$p_m = (M - P*R1)*(1 + R1)^{m-1}$$

Now the total principal to be paid over Y years (ignoring the balloon payment) is the sum of all these m payments from m=1 to M=N, where N=Y*T and represents the total number of payments that would be made over Y years if not interrupted by the balloon payment.

If we form this summation, we find that we have a geometric series which can easily be evaluated. Thus we obtain for the total principal

$$P=(M-P*R1)*\ \frac{(1+R1)^{N}-1}{R1}$$

But we already know the value of the total principal, P. Solving for M we obtain

$$M = \frac{P*R1*(1+R1)^{N}}{(1+R1)^{N}-1}$$

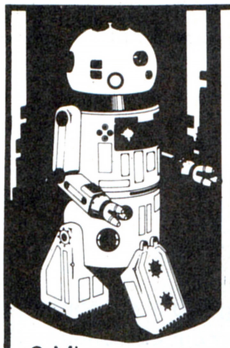
This is the equation that appears in statement number 105 of the program.

As stated before, the rest is easy. The total payment made before the balloon payment is due is M*T*Z; (statement number 106). To obtain the total principal paid before the balloon payment we take the above equation for P and change the N from Y*T to Z*T. We now have the principal paid during the first Z years instead of the entire Y years; (statement number 107). The balloon payment, B, now is simply P minus the principal paid before the balloon payment; (statement number 109). The total interest paid equals the total payments made before the balloon payment minus the total principal paid before the balloon payment; (statement number 110).

In order to construct the amortization table we use the previously derived equation for the principal part of the mth payment, p_m; (statement number 150). The interest part of the mth payment is then simply $M-p_m$; (statement number 155).

Program MORTPAY is written in PolyMorphic BASIC, Version A00. In use, the operator is asked to state the principal value of the debt, the annual interest rate in percent, the number of payments per year, the number of years over which the debt is amortized, and the number of years after which a balloon payment, if any, will be required.

Provision is made in statement number 89 for as many as 240 total payments (monthly for 20 years, for example). If more are needed, the DIM parameters may be expanded. Output consists of a recital of the input conditions, the amount of the balloon payment,



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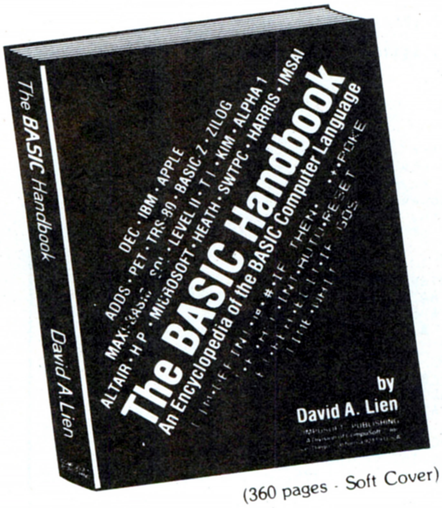
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CIRCLE INQUIRY NO. 49

the periodic payment, the total interest, the total amount paid over the lifetime of the debt, and an amortization table.

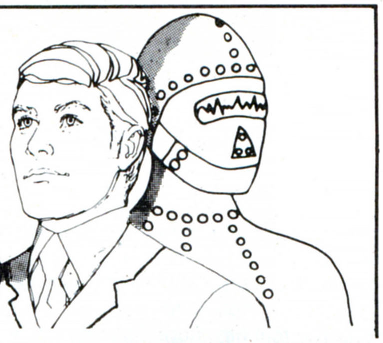
At the bottom of the table the interest and principal totals are given. Note that these totals may not agree to the penny with the total given in the initial part of the output. Both are in a sense correct. The amounts stated initially are the exact amounts. The totals given below the tables are the amounts the debtor will end up paying due to the requirement that each periodic payment be rounded off to the nearest penny.☐

Alfred Adler may be contacted at 10360 E. Flintlock Trail, Tucson, Arizona 85715.

PROGRAM

```
>LIST
10 REM**************************************************************
15 REM
20 REM$$$$$$$$  P  R  O  G  R  A  M   M  O  R  T  P  A  Y  $$$
25 REM
30 REM%%%%%%%%%%%%%  Version  1.0  %%%%  February  1979  %%%%%%%
35 REM
40 REM$$$$$$$$$$$  Written  by  -  Alfred  A.  Adler  Ph.D.  $$$$
45 REM
50 !"Assume a debt of P dollars, with an interest rate of R %"
55 !"per year. Initial payments of M dollars each are to be"
60 !"made, at the rate of T payments per year calculated over"
65 !"a period of Y years. However, at the end of Z (equal to"
70 !"or less than Y) years the debt will be retired with a"
75 !"single balloon payment of B dollars."
88 !
89 DIM P(240),I(240)
90 INPUT "STATE P,R,T,Y,Z,:",P,R,T,Y,Z
92 N=Y*T
94 R1=R/(100*T)
95 K=(1+R1)^N
105 M=P*R1*K/(K-1)
106 P8=M*T*Z\REM TOTAL PAYMENTS BEFORE BALLOON PAYMENT
107 P9=(M-P*R1)*((1+R1)^(T*Z)-1)/R1
108 REM P9 IS TOTAL PRINCIPAL BEFORE BALLOON PAYMENT
109 B=P-P9
110 I=P8-P9
115 !"DEBT = ",%$8F0,P,TAB(20),"INTEREST RATE = ",%5F2,R,"%"
120 !"TO BE PAID OFF AT THE RATE OF",T," EQUAL PAYMENTS PER"
122 !"YEAR, CALCULATED OVER A PERIOD OF",Y," YEARS."
125 !"AT THE END OF",Z," YEARS, A BALLOON PAYMENT OF",%$11F2,B
130 !"WILL RETIRE THE DEBT."
132 !\!"EACH PAYMENT WILL BE ",%$10F2,M
135 !"THE TOTAL INTEREST WILL BE ",%$10F2,I
137 A=P8+B
138 !"AND THE TOTAL AMOUNT PAID WILL BE",%$11F2,A
140 !\!"PAYMENT NO.",TAB(18),"PRINCIPAL",TAB(33),"INTEREST"
141 P3=0\I3=0
145 FOR J=1 TO T*Z
150 P(J)=(M-P*R/(100*T))*(1+R/(100*T))^(J-1)
151 P3=P3+P(J)
155 I(J)=M-P(J)
156 I3=I3+I(J)
160 !%5I,J,TAB(16),%10F2,P(J),TAB(30),%10F2,I(J)
165 NEXT
170 !\!"TOTALS",TAB(15),%$11F2,P3,TAB(29),I3
>
>

>RUN

Assume a debt of P dollars, with an interest rate of R %
per year. Initial payments of M dollars each are to be
made, at the rate of T payments per year calculated over
a period of Y years. However, at the end of Z (equal to
or less than Y) years the debt will be retired with a
single balloon payment of B dollars.

STATE P,R,T,Y,Z,:56000,10,4,13,5
DEBT =  $56000.      INTEREST RATE = 10.00%
TO BE PAID OFF AT THE RATE OF 4 EQUAL PAYMENTS PER
YEAR, CALCULATED OVER A PERIOD OF 13 YEARS.
AT THE END OF 5 YEARS, A BALLOON PAYMENT OF  $42303.57
WILL RETIRE THE DEBT.

EACH PAYMENT WILL BE   $1936.18
THE TOTAL INTEREST WILL BE  $25027.09
AND THE TOTAL AMOUNT PAID WILL BE  $81027.09

PAYMENT NO.       PRINCIPAL      INTEREST
    1               536.18        1400.00
    2               549.58        1386.60
    3               563.32        1372.86
    4               577.40        1358.77
    5               591.84        1344.34
    6               606.63        1329.54
    7               621.80        1314.38
    8               637.34        1298.83
    9               653.28        1282.90
   10               669.61        1266.57
   11               686.35        1249.83
   12               703.51        1232.67
   13               721.10        1215.08
   14               739.12        1197.05
   15               757.60        1178.57
   16               776.54        1159.63
   17               795.96        1140.22
   18               815.85        1120.32
   19               836.25        1099.92
   20               857.16        1079.02

TOTALS         $13696.43     $25027.09
>
```

THE MIND REVOLUTION



By Merl Miller

Last month we discussed the concept of polite programming; that is, how can we make computers accessible. With this in mind, the following table was introduced:

if a naive user typed this	this is what the user probably wanted
add	Add
A	Add
I want to look at some	Look
I wanto make a change.	Change
dlete	Delete
quite	Quit
Chagne	Change
I don't want this recond here any more.	Delete
I give up!	Quit
• • •	

This month we will begin a discussion of each of the possible naive user responses and think about what would be involved in writing a menu routing that could handle them. The first *add* is fairly obvious. Any menu routing should be able to accept a properly-spelled single word when it appears in the display, especially if the word uniquely identifies the desired response.

Now, in our display the word *Add* appears with a capital *A*. But surely lower-case letters must mean the same thing as their upper-case versions! The first step, then, is to have a program that will handle either lower case or upper case and accept either as correct. If we convert all user responses to lower case and compare these responses to a list of words that occur in the menu prompt, we'll be able to handle quite a few responses.

The second naive user response is *A*. Now, that should be a reasonable abbreviation of one of the key words in the menu display so, surely, we can handle it. If we keep a dictionary with the entries shown in Example 1 then, as long as we convert the user response to lower case, we can tell what was meant by just finding a match in the dictionary. (In the example, if the array of dictionary words starts with position 0 and a match is found at position *m*, the response is (*m*/2) +1).

dictionary words
add
a
change
c
delete
d
look
l
quit
q

Example 1

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CIRCLE INQUIRY NO. 12

The third naive user response, *I want to look at some,* isn't really much harder to handle. We can use the same dictionary we used in Example 1; but now the menu routine has to be able to divide the user response into individual words. Then it must look through the dictionary to see if any of the words in the response are found. There is the additional problem of two words in the response being in the dictionary. This means that, unlike before, the menu routine can't quit if it finds a match. It has to go through the entire response string, making sure that any other words that match the dictionary are in the same category as the first hit. Table 2 shows how the menu handles the problem.

rules for splitting a phrase into words:

1. if length (*phrase*) = 0 then no words (left) in *phrase.*
2. ignore beginning blanks.
3. *position* = the position of the leftmost blank, comma, period, colon, semicolon, question mark or exclamation point.
4. everything from the start of the string, up to but not including *position* is a *word.*
5. remove the *word,* and the character at position *position* from the *phrase* (or from consideration, depending on how you're doing things).
6. go to step 1

Example: If the *phrase* is

I'll be wantin' to look, yes sir!

then the *words* found in the *phrase* are

I'll | be | wantin' | to | look | yes | sir

Table 2

The fourth naive user response, *I wanto make a change.,* looks like it should be easy to handle, at first. Our menu goes through the dictionary, finds a match on *change* and that's that. Right? Wrong! Look at the word just before *change*; it is also in the menu and has a different meaning.

Now, what do we do? Throwing the computer out the window would certainly be one approach, but there are others. Certainly, we don't want to throw out the idea of allowing a user to answer with a single letter. Experienced users will want to type as little as possible; so if a single letter, *a,* comes in, we definitely want it to mean *Add.* On the other hand, if our routine replies:

> *I'm sorry, but I don't know if you mean*
> *Add a new record or Change an existing record*
> Please go away.

When the naive user has typed *I wanto make a change.,* that would be rude.

It seems a reasonable solution would be to have the menu routing ignore any single letter words in the dictionary if they appear in a response that has more than one word in it. We think that's reasonable because only naive users will be entering long phrases with a lot of unnecessary words. We don't want to penalize experienced users by forbidding single-letter responses. The real beauty of this approach is that it won't cost much in time or space to write our menu routing this way. Thus, a response like:

I want to D

would be unintelligible to our routine.

If our solution to the problem offends you, you will probably want to come up with some way of recognizing when a short word is used as an article. One cheap way would be to say that *a, an* or *the* is an article if, and only if, it is followed by at least one word. Of course, that still rules out things like:

I'd like to A one.

The remaining responses should be treated together so we will get into them next month. You might want to think about how a computer system could handle spelling errors. The popular notion of computers is that they are totally intolerant of spelling errors; so a menu routine that can handle spelling errors would be quite a hit in the office. How much of a problem is it? What would you do? Next month, we will show you a solution.

This month's column was developed from an original manuscript written by Rich Didday which is part of his forthcoming book, *Principles of Polite Programming.* ☐

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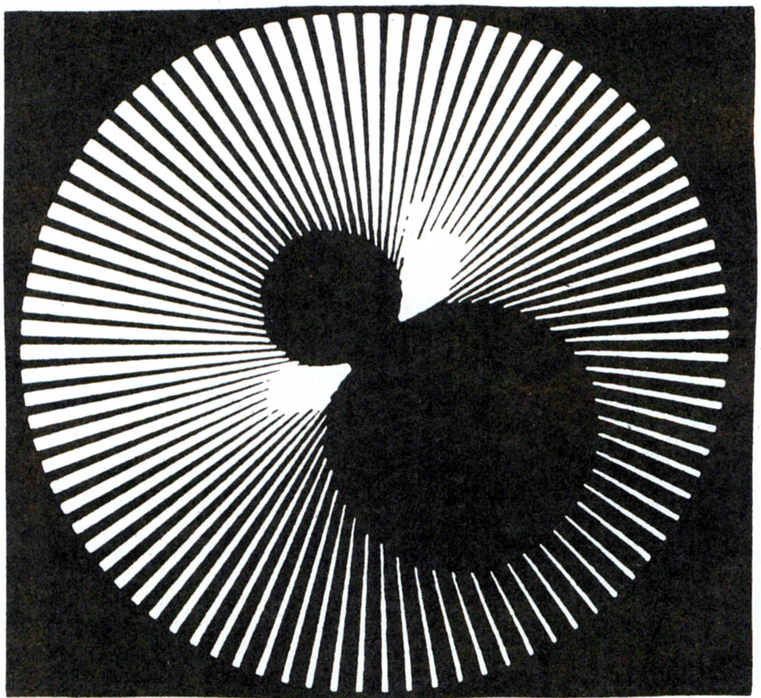

CIRCLE INQUIRY NO. 56

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THE INVENTOR'S SKETCHPAD

By Roger Garrett
Northeastern Regional Editor

HEARING FOR THE DEAF

The National Science Foundation has recently been funding an unusual experiment to bring "hearing" to the deaf. It is aimed primarily at those who have already learned lip reading; that is, the ability to understand spoken words by "reading" the lip movements of the speaker. The problem with lip reading, however, is that certain sounds "look" the same, in terms of lip movement.

Watch a person as they pronounce the words "what" and "when." It is quite easy to see the "wh" sound of each word, but it is virtually impossible to distinguish the "t" sound from the "n" sound. It was discovered, however, that those sounds which are difficult for the deaf to understand via lip reading are quite easy for a computer to understand by listening to the sound pattern.

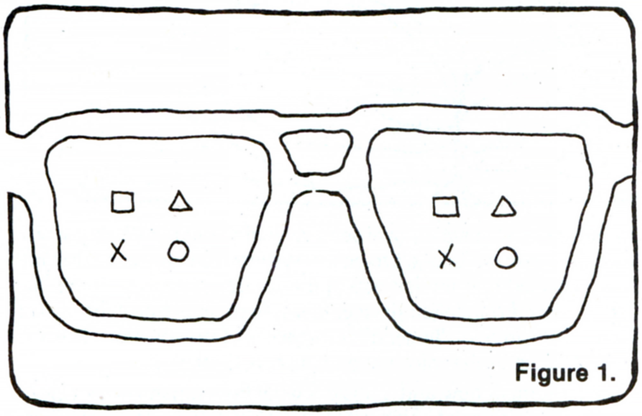

Figure 1.

By utilizing this phenomenon, a special pair of glasses was constructed, as shown in Figure 1, which provides to the deaf person the information queues which fill in the missing information in spoken speech. As the deaf person looks through the glasses at the speaker, he reads his lips. At the same time a microprocessor is listening to the speech and when it recognizes one of the prestored speech phonemes (such as the "T" or "N" sounds) it momentarily flashes a special symbol corresponding to that phoneme on the glasses.

The lens system is set up so that the symbol appears to "float" out in front of the wearer. The symbols are normally invisible and only flash on when the computer recognizes a sound. These flashing symbols thereby provide the missing information, the sounds which are hard for the deaf person to distinguish by lip reading alone.

It is an intriguing approach to an obviously difficult problem. There are, of course, drawbacks to such a system. First of all, the deaf person must have a good mastery of lip reading, a not-so-trivial task. He must then also learn the symbol system which is flashed by the special glasses. Finally, such a system does no good unless the user can actually see the speaker, because it relies on lip reading, and it is of no use for non-speech sounds. The deaf person still has no perception of doorbells, music, animal sounds, and the myriad of other sounds that fill the atmosphere.

I offer here an alternative. I believe that the previously described method takes the right initial approach, that of employing visually-encoded information, but that it does not take it to the logical con-

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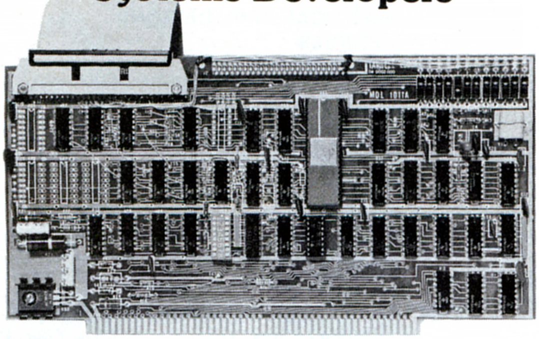

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clusion. The system uses visual information as an addition to existing information, the existing information being the lip movement of the speaker. I suggest that the computer-generated visual information completely replace the other forms of information. The human eye/perception system is an extremely sophisticated pattern recognition system. I suggest that we provide a device which will display audio information to the eye and let the eye/perception system provide the "hearing" ability.

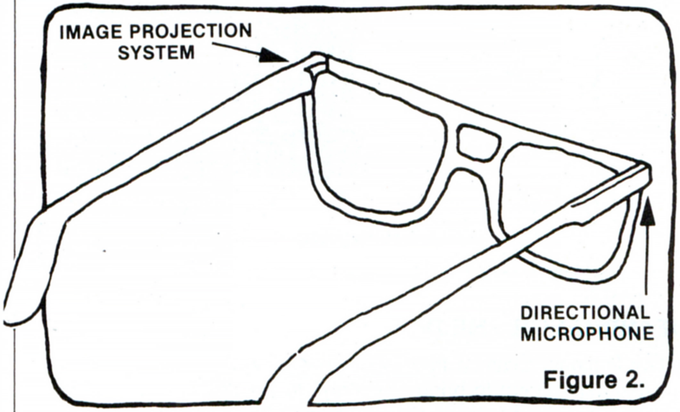

Figure 2.

In Figure 2 we have a modified set of eyeglasses. On the right bow is mounted a simple directional microphone which will provide the audio information to the microprocessor. On the left bow is mounted an image projection system.

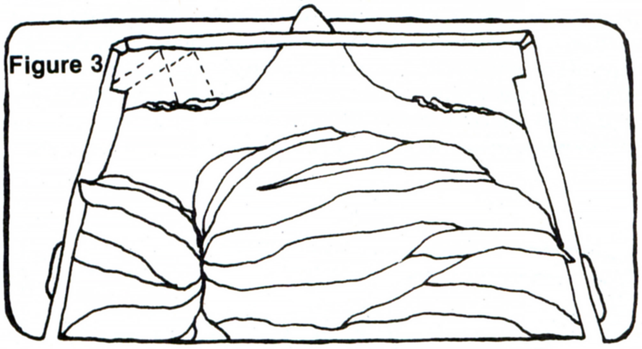

Figure 3

In Figure 3 we have an overhead view of the glasses being worn. We can see that the image projection system is set up so that the image is deflected into the left eye of the wearer. Just as with the National Science Foundation device, this system would give the viewer a view of an image "floating" in space in front of him. The difference here is in the information which is displayed.

Take a moment now and consider what the human ear perceives when sound is present. The ear is basically a frequency analyzer. That means that it detects the amplitude of a given set of frequencies. The brain then utilizes this information, matching it to known (previously learned) patterns of frequency/amplitude sets and "tells" us what the sounds are. The key point here is that the brain does the listening and understanding. The ear merely acts as a preprocessing input device. It is preprocessing to the extent that it divides the sound into its component frequencies and corresponding amplitudes before sending it to the brain.

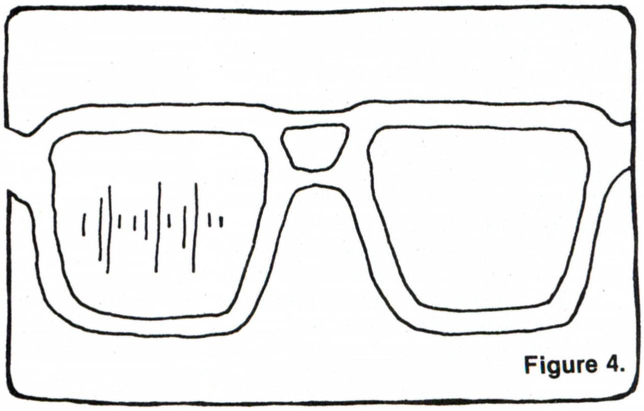

Figure 4.

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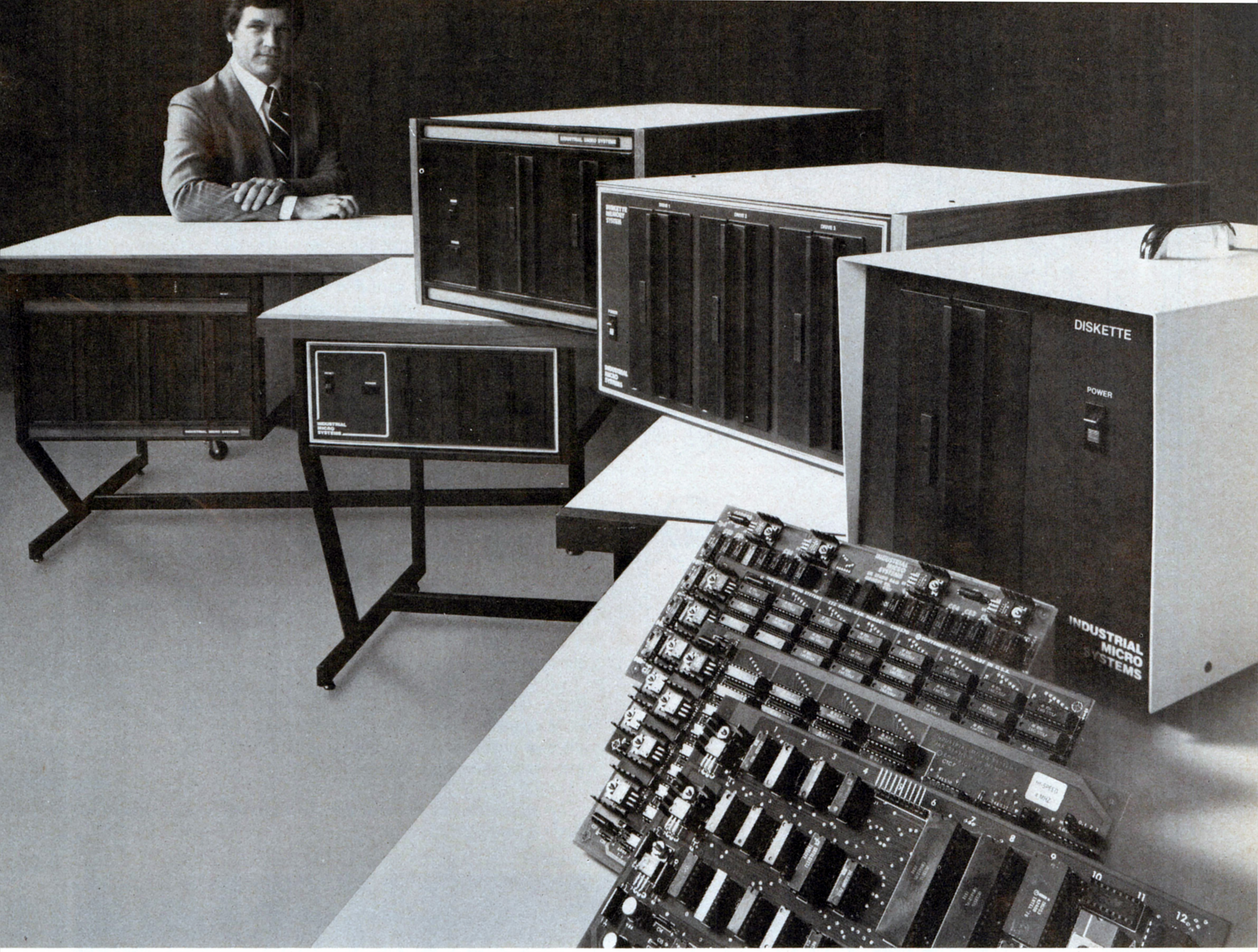

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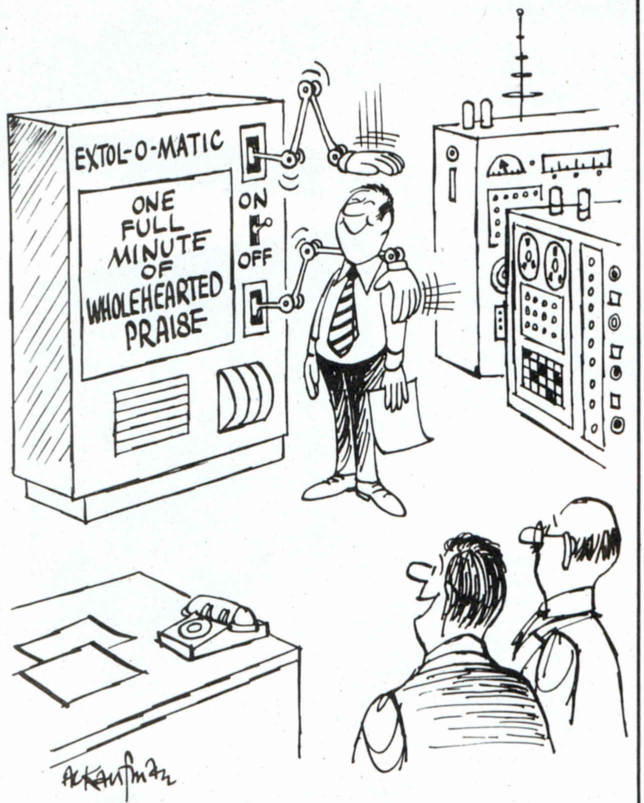
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Might it, therefore, be possible to substitute one preprocessing input channel for another? Could we, indeed, replace a microprocessor and the human eye for the ear? I suggest that it is possible.

The image that would be displayed to the wearer of this set of glasses would be a frequency/amplitude graph of the instantaneous sound. A microprocessor would take the sound heard by the microphone in the right bow, do a frequency analysis of it, and display the information to the left eye as a set of varying height lines, as depicted in Figure 4. The lines at the one end of the scale would represent the lowest frequencies; towards the other end would be the highest frequencies. The height of each line would correspond to the instantaneous intensity of the sound at that frequency.

It may appear that learning to recognize sounds by watching these dynamic patterns would be a major undertaking. After all, there are hundreds of thousands of different sounds; no one could possibly consciously remember and be able to recognize even a small set of patterns. The key here is that we do not need to memorize them, we would *learn* them, just as we learn to see and feel and taste. It is not a conscious act.

Our input devices (eyes, ears, etc.) provide information to our brain. The brain processes the information, establishing relationships between the varying inputs, and we learn to recognize different sensations, not because we actively attempt to memorize them, but because the brain is set up (via millions of years of evolution) to properly establish relationships among the varying information it receives from the senses. By simply wearing the glasses and constantly providing the wearer with the visually-encoded audio information, he will learn to "hear" the sounds. He need make no conscious effort to recognize the patterns, just as those with full hearing abilities make no conscious effort to learn to hear with their ears.

I will concede that it may be difficult for the deaf adult who has already learned other means of "hearing" such as lip reading. I would suggest, therefore, that initial studies of this method be done with deaf children while at the same time providing them with the more conventional approaches.☐

The author can be contacted at 16 Grinnell Street, Jamestown, Rhode Island 02835.

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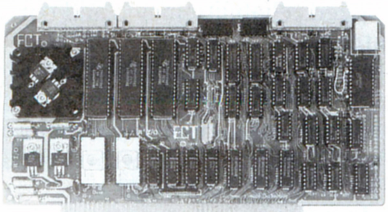

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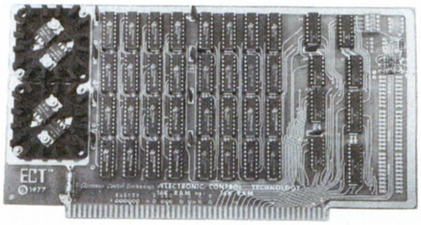

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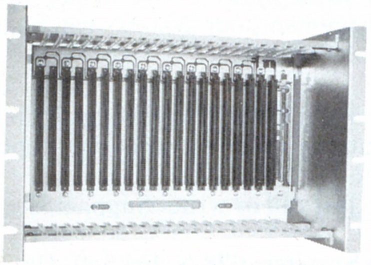

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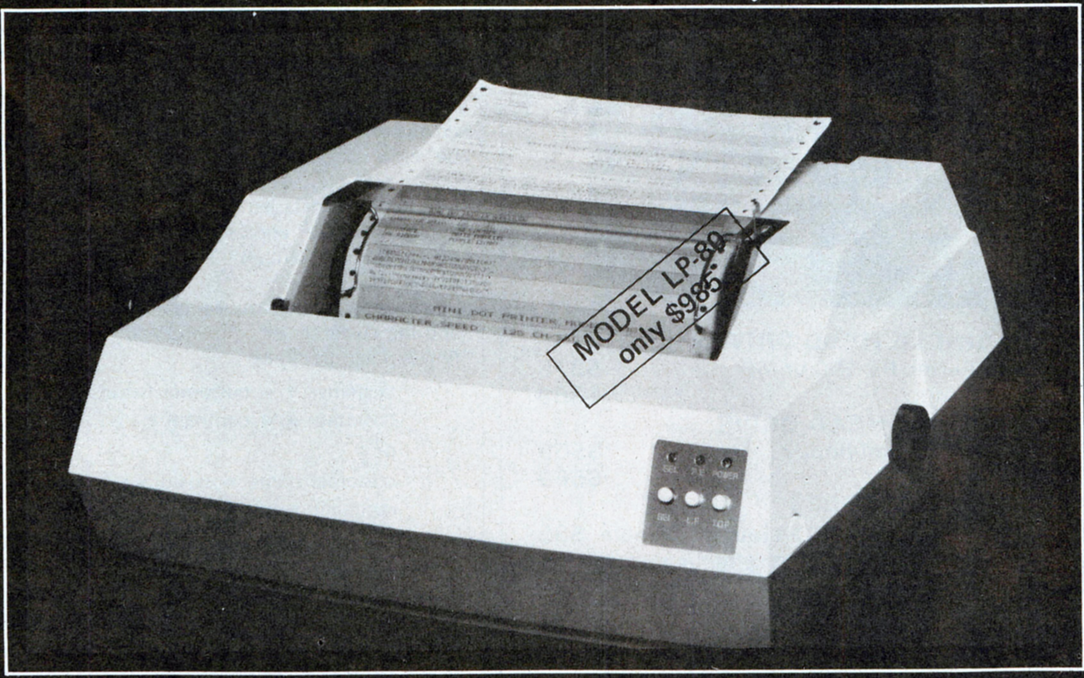

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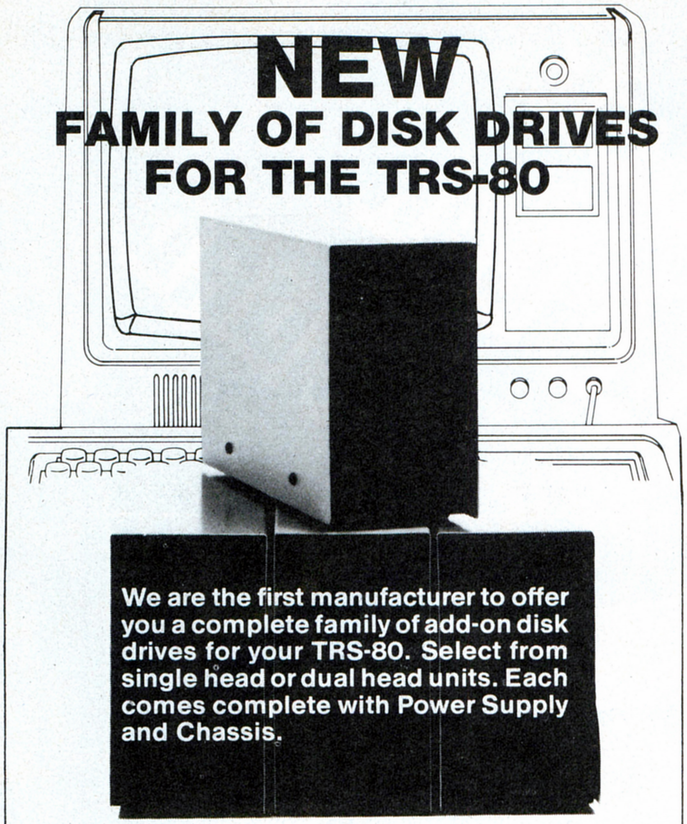

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R.H.D. real handy data

By Robert H. Distler

During the past several months, I have been discussing databases in the terms of the ideal, and their basic layout. Inputs to a database were discussed, along with the concept of the schema and subschema. The point at the time was to show that relationships do exist between data items, and that by establishing logical links, entire records can be retrieved, based on one item held within the data record.

For example, last month we created a record for our mail list file by asking for data items that included a customer number, name, company name, address, city, state and zip codes along with a phone number. Within this record are several items that are related to the others.

The most obvious relationship is between the customer number and the customer or company name. Therefore the following relationship can be drawn:

customer # = customer name
customer # = company name
or
customer name = customer #
company name = customer #

The point of this example is that a definite relationship does exist between items within the record, which means that flexibilities can be built into the computer to locate and process individual records within a given file; and, incidentally, more over-file boundaries for inter-file processing of data.

The concept of the Data Base Management system is very much in evidence when data relations are discussed. In fact, data relationships are the foundations of database management systems.

Realizing that the same ground has been gone over several times during the past months, I must point out that in order to understand how a database and a database manager function, the basic concepts must be fully understood.

BACK TO THE MAIL LIST

Each time, we come back to our mail list and develop some new understanding of what should happen. No provisions have yet been made to save the data on an external media, such as disk, nor were any provisions made to edit or update the record. These items will be discussed this month.

First, once a record is created and entered using the application software, it must be saved on the external media for later use. The saving of data on an external media is not the function of the application, but of the operating system software. Most disk systems allow programs to be saved by using something like: SAVE "MAILLIST. BASE:1" to save a program called maillist which is in BASIC — the extension .BAS on drive number 1. This is the program and not the data, however. Therefore, most BASICs that are disk interactive provide OPEN statements to allow access to a record for updating. The file can be OPENed either as a sequential or random file depending on the type of operation you are engaged in.

For the purposes of this discussion, RANDOM files are assumed since the record can be anywhere within the file structure and is retrieved due to some unique relationship.

Without going into the actual mechanics of the retrieval, the idea of editing or updating the records is next most important. What good is data if it cannot be corrected or updated?

Consequently, in any data organization structure the ability to retrieve a record within a given file and update it is imperative to the total operation of the system.

Looking again at the data record created for our mail list, we find eight possible fields that could be corrected or updated. An assumption could be made that field one, the customer number area, would always remain the same and would be updated only if the original record were destroyed or deleted. This can be a safe assumption since the customer number is unique to the contents of that record only and possibly links to other data regarding that record held in other databases.

Making this assumption leaves only seven fields that need be updated and, incidentally, are only unique because they are different from other records. It should be understood that to change record number 1234 from SMITH to JACKSON would be OK if it was understood that for all practical purposes the index item 1234 was no longer associated with SMITH and that all links to the number were updated to contain information on JACKSON rather than SMITH.

The tricky part is ensuring that the updated record goes back where it came from and can again be retrieved.

The process of editing the record is simple and involves the location of pointers within the various fields of the record and overlaying the old information with new. The tricky part is ensuring that the updated record goes back where it came from and can again be retrieved with any of the given keys — this becomes the function of the database manager working with the operating system.

HOW THE DATA LOOKS

Data can be represented in a variety of ways both in the internal RAM of the computer and on the external media. The actual data can be saved in an ASCII format, meaning that each character is represented by its ASCII equivalent which is converted into the correct alphanumeric character on retrieval or in a compact form that is associated with the language and the operation system.

One unique way of saving data on tape is to convert it all to integers and, in the case of BASIC, save the integer array on the tape. But this is cumbersome and can result in some amazing errors creeping into the data.

The best way to handle the data is to view it in a manner that is exactly how it looks when you entered it.

The system software consisting of the database manager if you have one and the operating system will take care of getting it onto the external media and returning it to you. Your basic concern is what to do with it.

SUMMARY

The last few months have provided a light, basic treatment of databases and data base management. There is, of course, more to the understanding of data handling than has been presented here. For those who wish to find out more on database construction and data handling, I suggest that you get a copy of *An Introduction to Database Systems* Second Edition Addison-Wesley 1977 by C.J. Date. Date provides an in-depth understanding of databases and provides enough information for the programmer to develop a usable system for the micro world.☐

Since this is the last R.H.D. column on data handling for this period, we have contacted a number of data handling experts to provide a series of articles on database handling software. During the next several months we plan to publish more full-scale articles on DBMS, ISAM and keyed access methods, and offer total DBMS packages for INTERFACE AGE readers. The author of this column can be contacted at P.O. Box 6376, Oxnard, CA 93031.

—Editor

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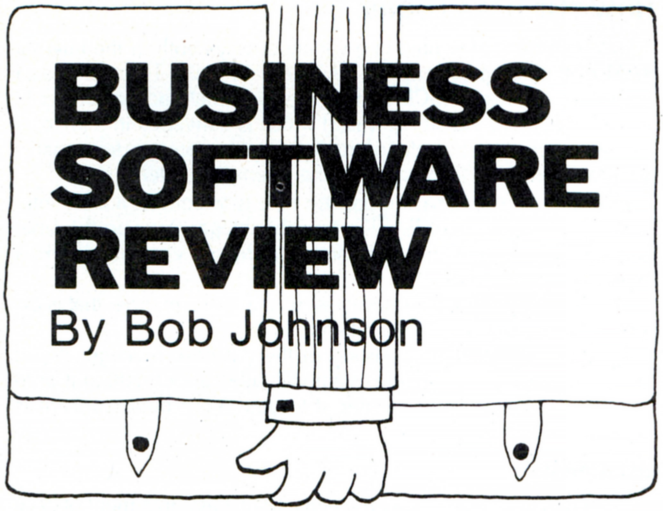


BUSINESS SOFTWARE REVIEW

By Bob Johnson

GRAHAM DORIAN SOFTWARE SYSTEMS

Graham Dorian Software Systems is a division of Graham-Dorian Enterprises, based in Wichita, Kansas. Among the various businesses owned by Graham-Dorian are a couple of apartment complexes, a golf course, and the Pro-Shop at the golf course. William Graham, Jr., president of GDE saw the possibilities of the Imsai computers in business management, and tried to buy the systems that he needed. After several months with nothing to show but a couple of computer systems, he hired a programmer and had the packages he needed written. The first four software products designed were an apartment management system, a payroll package, an inventory system and a cash-register (point of sale) system.

These were well tested at GDE and several other businesses in and around Wichita before GDE formed the Software Systems Division, and started marketing the programs.

GDE Software also announced four new packages this year. These are General Ledger, Accounts Payable, Accounts Receivable, and Job Costing. All of the GDE packages are designed to run interactively with other GDE packages. The user can start with one package and add others at any time.

SYSTEM REQUIREMENTS

All of the GDE packages run under Digital Research's CP/M and the CBASIC-2 language. You will need a microcomputer with CP/M, at least 48K of memory, CRT terminal, printer capable of 132 characters per line, and at least two floppy diskette drives.

Each of the GDE packages is supplied with CBASIC-2, program diskettes, comprehensive user's manual, and source code. The source code is extremely important, because it allows the user to modify (or have modified) any of the GDE packages to exactly fit his needs. Programming and modification information is given in the user's manual.

This month's software review will be on two of the GDE packages, the Apartment Management and Payroll Systems. The apartment management package is designed for complexes of 75 or more units, and provides complete management information on the current rent/vacancy status, and daily transaction reporting. It does not include basic accounting such as the General Ledger, although it does perform the basic functions of an Accounts Receivable system.

The Payroll package handles the figuring of each employee's payroll and deductions, handles the payroll reporting and Federal forms, and also will print checks and W-2's for each employee. One nice feature of the Payroll package is that GDE supplies the system with your state's tax tables already incorporated into the package.

THE GDE APARTMENT PACKAGE

The Apartment Management Package keeps information on all apartments, past tenants, and financial income. Reports are generated to provide management with current information on each of these three areas.

The Apartment File

This is the master file in which is kept all the current information on each apartment, such as:

- Apartment Number and Address
- Rent & Deposit
- Tenant's Name & Paid-up-to-Date
- Date Moved In and # Days Credit
- Utilities Paid by Tenant ?
- Pet, Amount of Pet Deposit ?
- Pool Key, Amount of Deposit ?
- Telephone Number
- Classified Comments
- Apt. Shown by:
- Paperwork filled out by:
- Notice to Vacate — Date to Vacate

This file contains the current information on each apartment. The system is provided with a program to create the files. Another program is used to originally enter information into the file. Once the file is set up, all information is maintained with the daily update program.

The Past Tenant File

All past tenants are placed in a file for future reference. This file contains the date moved in, date moved out, condition of apartment, and total length of occupancy.

The Financial File

All information on income is kept in a financial history file. The items kept include: Rent Collected, Damage Deposits, Pet Deposits, Pool Key Deposits, Income from Utilities, Income from Laundry, Late Rent Charges, and other Misc. Income.

Other Reports Generated

The following reports are available to the user of the GDE Apartment package:

- Late Rent
- Vacant Apartments
- Apartments Coming Vacant
- Tenants with Pets
- Tenants Paying Utilities
- Maintenance Data
- List of All Apartments and Current Status
- List of Classified Comments

These reports may be generated at any time.

Letter Writing

An additional feature is the ability to write letters and automatically have them addressed to selected portions of the tenant list.

Conclusions

The GDE Apartment Management Package performs well. It is specifically designed for the style of management practiced by GDE, so in most cases, you will want slight modifications made to the package. It would be a wise idea to make arrangements with the dealer to do the necessary modifications. Those of you who have programming experience should be able to do the modifications yourself. The manual has very comprehensive instructions and comments regarding programming changes.

THE PAYROLL PACKAGE

The GDE Payroll Package is a general purpose package which handles the computation of payroll and withholdings, prints paychecks, and keeps cumulative quarter-to-date and year-to-date information on each employee. It will also print the quarterly Federal withholding forms and the employee W-2 forms.

The Payroll package is menu driven and has extensive error checking on user inputs. The functions available under the Payroll Package are as follows:

- Enter or Change Employee Information
- 'Hold' Employee Payroll Calculation for Special Deduction Figuring or Special Check Printing
- Input Hours Worked by Employee
- Calculate Payroll and Deductions
- Verify Payroll Calculations
- Make Corrections if Needed
- Print Payroll Checks
- List Cumulative Payroll Information

The Employee File

The Employee Payroll File contains all the current information for each employee. This information is as follows:

- Name and Address
- Employee Number and Social Security Number
- Marital Status and Number of Withholdings
- Division Number
- Hourly/Monthly Pay and Pay Rate
- Dates Started/Terminated
- Medical and Misc. Deductions
- Quarterly and Annual Pay and Deductions

Once this file has been created with the file initialization program, all update is done either automatically, or with the employee file maintenance section (available from the menu).

> **After searching in vain for a system, GDE had its programs custom-written.**

The Terminated Employee File

Employees who have been terminated are removed from the master employee file and placed into a terminated employee file. This is done to retain the pay records for future reference and printing the W-2 forms at the end-of-year.

The Check Register File

A file of paycheck information is retained by the system. The payroll and deductions figures are placed into this file after calculation, and checks are written by the system using those figures. When a check is written, the system notes this fact in the check register file, and retains the figures for reference if needed. Checks may also be issued individually for special pay situations, such as contract labor.

The Quarterly Information File

All the quarter-to-date pay and withholding information is summarized and put into the Quarterly Information File. This file is re-initialized at the beginning of each new quarter, and may be used to keep track of payroll tax deposits and related information.

Using the Payroll Package

Once the files have been initialized, operation of the Payroll package is quite simple. Each employee's hours are entered into the system. After all hours worked have been entered and verified, the system will calculate the payroll and deductions.

A listing of all pay and deductions by employee is then generated and verified. Next, the system prints the paychecks for all employees.

Several reports can be generated by the user. These include:

- Master Payroll Register
- Employee Data by Category or Division
- Quarterly Information
- Print W-2 forms

The letter-writing feature is also incorporated.

Conclusions

The GDE Payroll Package will handle most companies' needs in payroll calculations. Most companies will need slightly different information or formatting, so again, count on needing some modifications. One nice feature of the Payroll package — it comes configured with your state's tax tables — you don't have to enter them yourself.

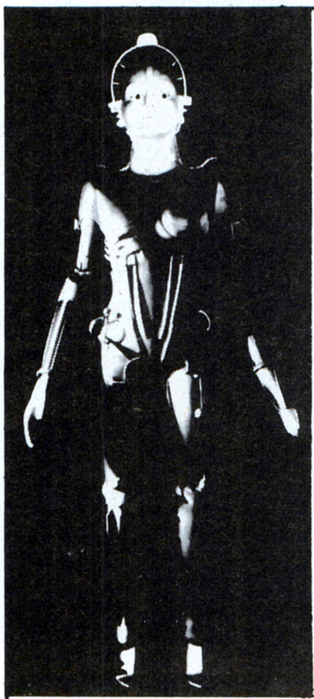
The GDE Software packages are available from Graham-Dorian Software Systems, 211 N. Broadway, Wichita, KS 67202, phone (316) 265-8633.

THE RATING CHART

This is a rating chart devised for use in this column to serve as a rough guideline on several key points of interest to the business user. For an explanation of the categories, see the April 1979 issue of INTERFACE AGE. Rating is on a scale of 1 to 10, 10 being the best.☐

	Apartment	Payroll
1. System Interchangeability	8.5	8.5
2. Program Interfacing	9	9
3. Maintainability	9.5	9.5
4. Documentation	8	9
5. Ease of Installation	7	8.5
6. User Lock-In	6	9
7. User Interaction	5	8
8. Input Error Checking	8	9.5
9. Error Recovery	6	9
10. General Design	8	8.5
Cumulative Total	**75**	**88.5**

Carl Heintz and Bob Johnson alternate as authors of this column. Software vendors interested in having their product reviewed can contact Carl Heintz at 2540 Huntington Dr., San Marino, CA 91108 or Bob Johnson at 7228 W. Reno St., Rt. 5, Oklahoma City, OK 73108.



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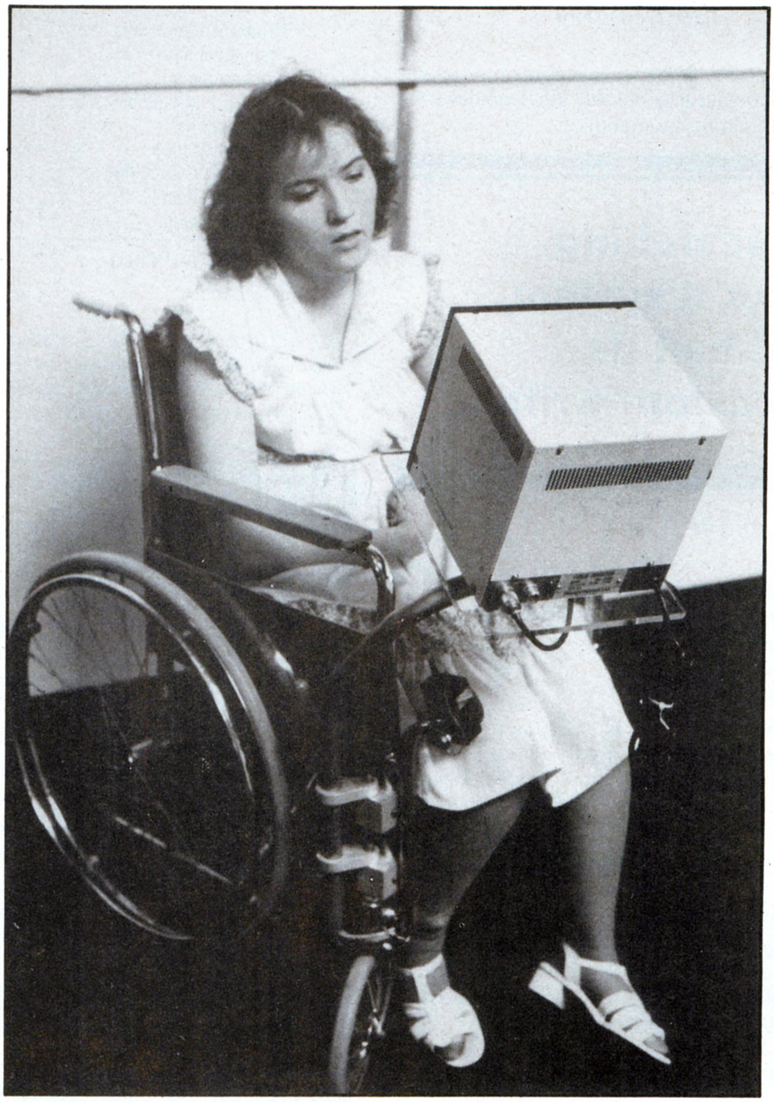
THE HANDICAPPED

Computerized Wheelchair

Despite the fact that 19-year-old Shirley Anderson cannot speak clearly or control the movements of her muscles, she is attending a Southern California junior college beside other students her age.



Her attendance is more of a personal triumph than any revolutionary advancement for the handicapped, but she is breaking some new ground. Shirley is working with a new system designed for persons who have a lack of muscle control and cannot communicate well.

Attached to the cerebral palsy victim's wheelchair is a computer and a small CRT that pivots in front of her. With this system, she can communicate with her teachers or classmates simply by printing a message on the screen. Since she can hear, there is no need for any input switch other than the one she uses.

The system, manufactured by Computers for the Physically Handicapped of Huntington Beach, California, can be altered to suit the needs of anyone with severely limited mobility and/or a lack of speech. In Shirley's case, it is designed around the only muscle she has consistent control of, her right leg. Near her knee is a switch that is interfaced to the computer, which is mounted on the back of the chair.

By hitting the switch, she can print any message she chooses on the CRT. A menu of system options continuously flashes on the screen, offering her a choice between programs for her studies, numerals, common phrases such as "I'm hungry," or the letters of the alphabet. When the selection she wants comes to the upper left of the screen (the entire run through takes only a few seconds), she hits the switch and enters the mode desired.

If she selects the alphabet, the letters appear in order of their common use or the next logical progression. For example, after she types the letters *sh,* the next letter appearing on the screen would be a vowel.

To speed the process, 1,200 words are kept in a file vocabulary. She can pick any of them to save time over the spelling. Only words of more than four letters are listed since it is quicker to spell out the short words. A message of up to 200 words can be put on the screen at one time.

Because the sophisticated invention is used by many young people, it was given a human name, TIM. Instead of the technical, important-sounding monikers often given computers, TIM is named after Tim Scully, the engineer and psychologist who designed it.

Since designing the system three years ago, Scully has decreased his involvement with the company. But before leaving he recruited Bill Lynas, a 44-year-old Swiss Ph.D. who graduated from high school at the age of 12. He has since become the driving force of the company.

Lynas spends much of his time customizing TIM for those who cannot speak or write, whether they suffer from birth defects, were injured in an accident or suffered a stroke. Many of the systems are designed to aid some of the one million Americans who suffer from cerebral palsy, a birth defect that impairs muscle control but does not impair a person's thinking.

Getting the system to fit the person's needs is the largest part of the task. If one of the company's standardized switches doesn't work, he must build a new one to take advantage of the muscles the person can control. In all but the most severe disabilities, a person can control at least one external muscle with consistency.

A writer in northern California uses his hand to work the system and turn out typeset copy that is camera ready for his publisher to use. A young boy in New Jersey operates the machine via an electro-myographic hookup that is attached to his right eyebrow.

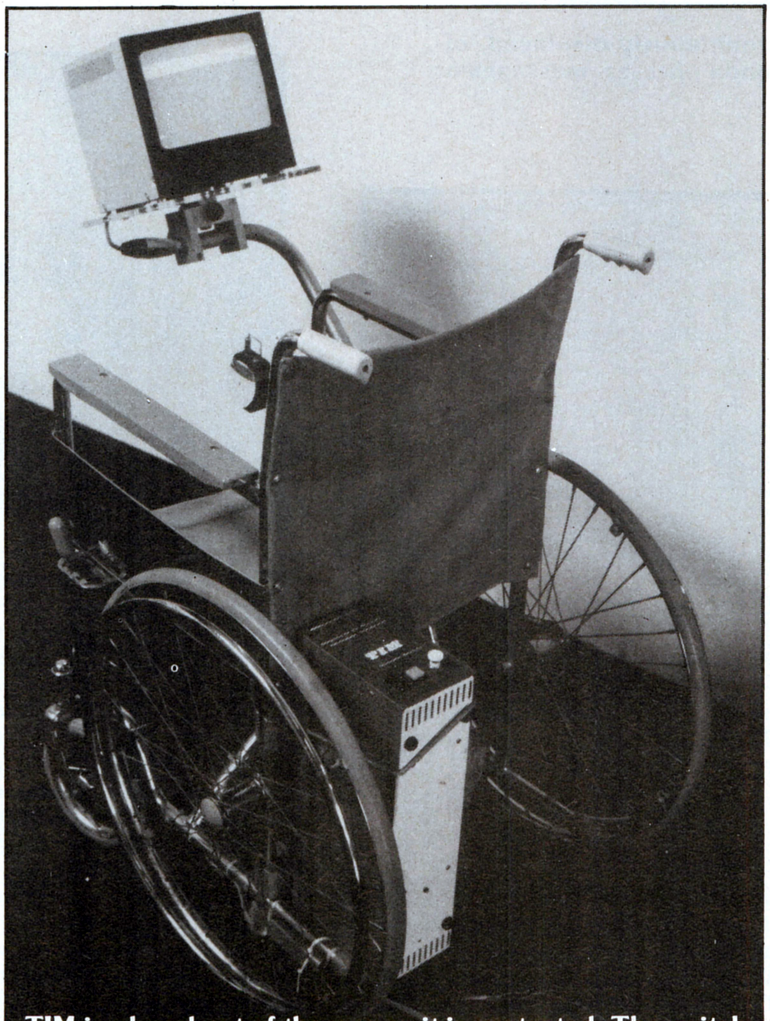
One of the most dramatic cases involves a teenager who was paralyzed in a moped accident. He lies in traction; if his head sinks onto the part of his neck that has no vertebrae, he

BYTE BACK Helps Disabled Communicate

By Terry Costlow, Editor

will die. But since he began using a breath-controlled TIM computer, he has regained much of his vital will to live.

"He has just opened up since he's started working with the system. He's blossomed just amazingly," says Dr. S. Clarke Smith, of the Los Angeles County Center for Rehabilitation.



TIM is placed out of the way so it is protected. The switch in front of the seat on the right lets Shirley control the system with her knee.

Dr. Smith has become quite enamored with the system since first seeing one about a year ago. "It's the fastest way for them to communicate that I've ever seen. With the normal ouija board types of alphabet, the alphabet is just there and the person points at letters to form words. But with this system they can become quite facile in a relatively short time. It's the state of the art right now."

Schools and hospitals are the main purchasers, since the cost is often out of reach for the individual. Most units can be used by any person after I/O ports are customized. The basic unit is altered only if necessary.

"It's a very ticklish situation to try to get something specialized that is still generalized enough so that when a person dies or the family wants to get out, it can be adapted to suit someone else's needs," Lynas says.

Several different computers have been used, ranging from the PolyMorphic, which is currently viewed as the best, to the TRS-80 and Apple machines. To keep costs at a minimum, CPH acts as an OEM for those who make boards, backplanes and other pieces in quantity. The company manufactures only a low power consumption CPU.

In order to stand up to the vibrations of being bounced over curbs, up and down stairs and other bumps of wheelchair travel, one of the major concerns in choosing a system is to get a computer that is not sensitive to vibrations or power fluctuations. The latter is important because the system must work with a small battery for mobility or a plug-in source, which is used most of the time. The popular S-100 bus computer with a five-slot motherboard was used to assure easy accessibility for repair parts. Lynas considers a 50,000-hour life span for the CPU good.

The software consists of 8K of ROM and 16K of user accessible RAM. It was written by Computer Communications Institute of Switzerland. Lynas, a former employee of that company, purchased the licensing rights from them.

Cassettes are used for data storage since the tapes withstand shocks better than disks. Their simplicity, availability and low price make them more attractive to handicapped who must live on a limited budget. The small amount of money these users have also creates a problem; those who need TIM the most cannot afford it. With a minimum cost of $2,200 it is a huge purchase for those on a limited or fixed income. Systems often exceed $10,000.

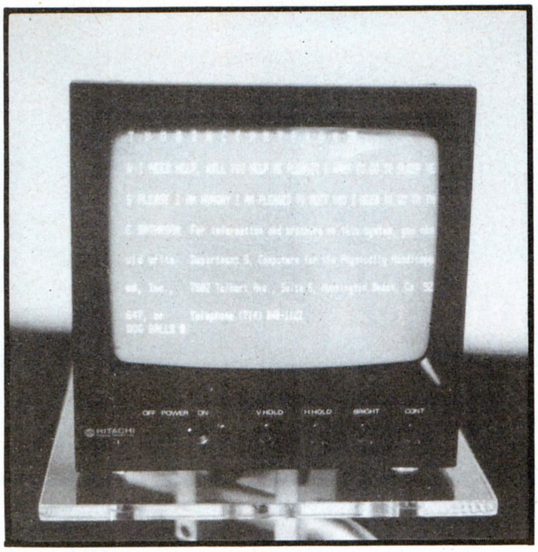
"It's not the cost of the equipment that's the main problem. It's that most of the people who need the system don't have any money," Lynas says.

Because of the Catch 22 involved — the people who need the machine to work can't buy one until they have a job — Lynas spends much of his time trying to get businesses and individuals to donate money. Some companies will make a tax-deductible contribution, and civic organizations and fire departments will often adopt someone until they gather enough money to buy a system.

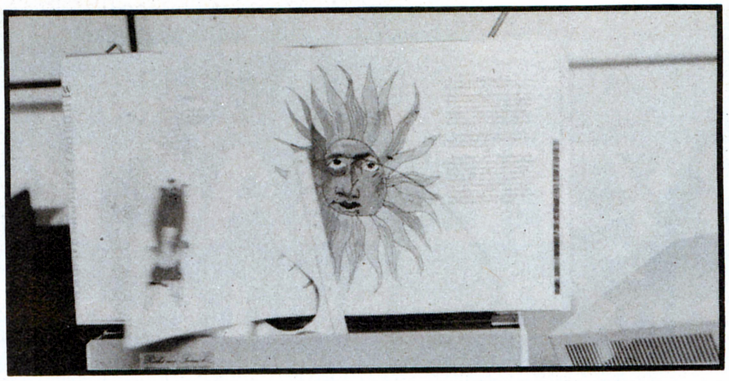
"Two-thirds of my time is spent trying to squeeze money out of people," says Lynas. Trying to get money is often not a pleasure. "I often get frustrated because I can't get enough money to help someone."

A substantial part of the cost stems from product liability insurance. Although no one has been hurt as a result of using the system, the risk of a lawsuit similar to those filed against Ford Motor Company after accidents with Pintos, is a constant fear. Lynas estimates these insurance costs comprise one third of the cost of a given system.

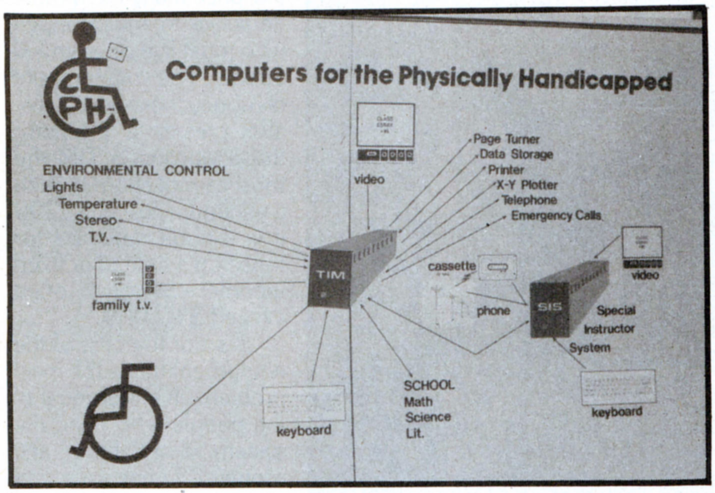
This high cost precludes any ideas of using the computer


OFF POWER ON
V HOLD
H HOLD
BRIGHT
CONT
HITACHI

Menu selections are continuously displayed, offering a variety of common phrases, messages or a choice of programs.



The page turner interfaces with the computer to allow users to read any sized book. A vacuum arm lifts the page so the lever shown here can turn the page ahead. The machine cannot turn pages backwards without much reworking.


CPH
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SIS
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Instructor
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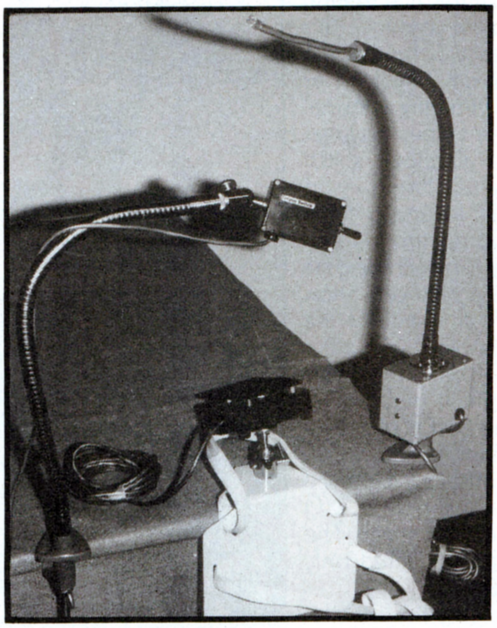
video
keyboard
SCHOOL
Math
Science
Lit.
keyboard

This display shows some of the options the TIM can be programmed to control. The system can be used in the home, at school or at work.



Switches can be adapted to suit nearly any person's needs. Variations include (from left) a tongue-operated switch, a chin switch which mounts on the user's chest and a puff-suck switch that is operated by breath control.

to help maneuver the wheelchair. Coverage of a system that could drive someone into traffic or a swimming pool would be too great for the small company.

Other than to facilitate navigation, the computer can be programmed to fit just about any person's needs. While studying, Shirley uses a page turner that is operated by the knee switch. When she finishes a page, she taps the switch and a suction tube rolls up from the base of her bookstand and lifts the page so a metal turner can flip it over. She can also command her computer to dial a phone number when she wants to call someone who has learned to understand her.

For those who cannot move, the computer can be connected to remote switches so the invalid can do such chores as turning on the lights, television set or the stove without help. The AC controller unit controls up to 32 remote units. These people do not need the communications part if they can speak, but life is much easier with an adapted TIM system.

For those who cannot talk, software is geared towards their particular requirements. For young children, simple phrases, rhymes and games are key needs. But for someone like an engineer, technical phrases and some drafting instructions are needed to continue a career. With an X and Y plotter, the system can draw on a drafting board or drum-type plotter.

To help keep the cost of customizing these units low, college students are often enlisted to write software for specialized uses. All software is geared around the basics of the licensed software written in Switzerland. Some users of the system have learned to program in FORTRAN to utilize the computer.

Computers for the Physically Handicapped is also beginning to apply for government grants to help them research the system and catch up on the backlog of orders. One of the key areas of research is speech synthesis and recognition. Scully is attempting to improve his system by devising these developments with the computer that bears his name.

Persons interested in finding out more about the company or contributing can write to: Computers for the Physically Handicapped, Inc., 7602 Talbert Avenue, Huntington Beach, CA 92647.☐

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CIRCLE INQUIRY NO. 4

Technology Extends the

Here, the Optacon from TSI is used by a blind computer operator to read data from his terminal screen.

Like prisoners with little chance of escape, deaf and blind people of the past were condemned to life without much hope for improvement or change. Although many advancements have been made since Louis Braille created a method of reading for the blind in the mid 1800s and Helen Keller achieved fame after the turn of the century, society has been slow to accept those who cannot see or hear.

But as people grow more aware of the problem, the handicapped are being given jobs and are being invited to take active roles in the mainstream of life.

Technology is doing its part to narrow the gap between the handicapped and non-handicapped. Research and development over the past decade have produced advances which have helped to eliminate the barriers faced by the physically disabled.

Telesensory Systems, Inc. is one company concentrating exclusively on the alleviation of physical disabilities through technology. TSI offers a number of electronic aids for the deaf, blind and visually impaired.

Possibly the best known of these devices is the Optacon, a reading system for the blind and deaf-blind. It was a result of the years of research devoted to this system that TSI was founded in 1970.

The Optacon, short for OPtical-to-TActile CONverter, uses advanced electronics to convert the image of a printed letter into a vibrating tactile form that a blind person can feel with one finger. Since it reproduces exactly what is printed, users can read different typestyles and languages with it.

The unit is compact, weighing about four pounds and similar to a small cassette tape recorder in size. The heart of the device is a miniature camera consisting of two tiny lamps and a silicon integrated circuit containing a total of 144 light-sensitive phototransistors, which correspond to the eye's retina. As the camera passes over an inkprint character, the phototransistors produce signals which are transformed into electronic impulses. These impulses activate rods in an array which vibrates to form a readable facsimile of the original printed image.

A number of controls are used to operate the Optacon. To compensate for different print sizes, a zoom lens adjusts the magnification of the camera image. A threshold control eliminates any obstacles presented by the differences in the reflectivity of inks and papers and the stimulator intensity control adjusts the vibration strength of the rods in the tactile array.

At home, the system allows blind people the independence to carry out all of those everyday tasks that most of us take for granted. Using this aid, they no longer require assistance in checking bills, cooking according to a written recipe or reading personal letters. Additionally, the system makes available reading materials which are not in braille or recorded on disk or tape.

In the work environment, the Optacon's versatility allows the blind worker a greater degree of independence than a standard braille system would. A blind secretary is able to read what she is typing, make corrections and even fill out printed forms simply by using the Optacon's typewriter attachment. The device can additionally be adapted to aid a blind computer programmer in not only reading a printout, but also reading the luminous display of a CRT terminal.

The Optacon offers blind students greater freedom and less dependence on special treatment in the classroom by making standard materials available to the blind. Students at all levels — from primary grades through college — are now utilizing the device.

A more recent breakthrough for the blind was the VersaBraille system, introduced by TSI in October, 1978. Incorporating state-of-the-art microprocessor technology in a personally-owned portable braille device, the "paperless braille" system offers a new dimension to written communications for blind people.

At the core of the VersaBraille system is a reading/writing unit that records braille information by means of electronic impulses on cassette tapes. The braille data is in turn displayed on a twenty-character line of electro-mechanical cells.

The cassettes used in this system can record up to 400 pages of braille, thus reducing the storage space required for materials and making the braille medium more portable.

With the VersaBraille's sophisticated microcomputer, the user is able to correct errors, insert additional data, organize braille in new ways and retrieve recorded material quickly. The VersaBraille unit contains a variable-speed audio tape recorder, enabling the user to combine both braille and voice on the same cassette.

At home, the blind person can perform a variety of home management chores with the VersaBraille. Keeping track of bills, maintaining telephone and address lists and keeping household data updated and accessible are all made simple with this system. The user can divide his cassettes into individualized sections, or "chapters," with each side of a cassette containing as many as fifty chapters.

Each chapter is titled as particular material is written. The titles may be letters of the alphabet for a telephone directory, the months of the year if the tape contains an appointment calendar, chapter titles for textbook material and so on.

Automatic location of a particular word, name or character grouping on a given page is simple with the VersaBraille unit. The user merely touches the search command on the unit and brailles the desired information (up to 20 characters). If there is no such entry on a given page a signal on the unit informs the user. If the desired character string happens to appear more than once on a page, the system can locate the grouping wherever it appears.

Capabilities of the Deaf and Blind

Use of the VersaBraille can enhance an employee's duties in a number of job applications. For instance, the blind switchboard operator can utilize the unit's easy location and correction of materials to find and update information in directories.

By combining braille and audio in the same system, VersaBraille brings new freedom in information recording to blind people. By pushing a single button, the user can convert the unit from a braille recorder to a standard audio cassette tape recorder with an extra feature: the user can record audio information with brailled section titles for automatic access of audio information by chapter title.

Another aid for the blind developed by TSI is the Speech Plus, often termed the "talking calculator." It is the only calculator available which allows verification of every keystroke and result through the use of a 24-word synthesized vocabulary.

In designing Speech Plus, TSI researchers consulted with a number of potential users to ascertain which features would be most desired. They found that most people wanted a unit that was easily learned and simple to operate, with as little room for mistake as possible.

The number of keys on Speech Plus were kept at a minimum to reduce the possibility of error. Custom programmed short-cut steps are combined with the automatic constant and independent memory to save time by reducing the number of keystrokes needed to solve a given problem.

The Crib-O-Gram provides early detection of hearing loss in infants.

Spoken verification is given for all keys, so guesswork in problem solving is eliminated. Every key is heard as it is pressed and the unit automatically abbreviates words if entry rate happens to exceed speech rate.

The Speech Plus keyboard is designed specifically for fast, accurate non-visual operation. The numeric keys are arranged in the same order as a push-button telephone.

In addition to its aid for the blind in work, the classroom and in performing household duties, TSI has developed a collection of eight electronic games for visually impaired people.

The Game Center uses a miniature computer to generate electronically synthesized speech and other audible electronic cues to provide the user with all the needed game information, including format and scoring. Each game has its own vocabulary, so the player needs only the audible output to play.

Included in the Game Center are electronic versions of Tic-Tac-Toe, Blackjack, Craps, Paddleball, Number Run, The Chain Game, Skeet Shoot and Tug O'War.

The variety of games available allows one person to play against the machine, two people to play each other or a group to take turns trying to beat each other's scores. There is an educational value to the system as well. The games can be used to improve such learning skills as memory retention, ear-hand coordination, sound discrimination and reaction time.

The Game Center is a compact unit — 16" x 14" x 14" — and comes equipped with a set of stereo headphones. The unit's automatic self-test assures the user that everything is in proper working order before he begins play.

TSI offers aids for the deaf as well as the blind. In some cases, detection of deafness in babies has been delayed two and a half years after the infant is born. In order to detect deafness earlier, the Crib-O-Gram was developed. It provides early detection of children with hearing loss who will not develop speech normally without hearing aids and/or special education.

The Crib-O-Gram utilizes microprocessor controlled testing to ensure accuracy and consistency. The tester can analyze hearing responses by comparing the baby's motor activity before, during and after a sound is introduced. The baby's scores are based on precise pass/fail criteria which employ microprocessor algorithms derived from a signal detection model.

The infant's activity is monitored before and after a narrow-band noise stimulus is introduced, and the unit automatically tabulates the output of the motion-sensing transducer.

Each infant tested requires only three minutes of test time, which includes simple calibration, set-up procedures and a button press. Moving the baby from its crib will not disturb the screening cycle. The system automatically stores response data and maintains a hold status until the screening process is re-initiated.

The unit analyzes and stores in memory the baby's pre-stimulus motor activity information, for use as a reference baseline for the test unqiue to that particular baby. The unit obtains separate baseline measures for each of the 30 trials.

The Crib-O-Gram was developed based on results from a four-year longitudinal study supported by the National Institutes of Health. Extensive field evaluations supervised by the Stanford University Medical Center at 15 hospital field sites, have screened over 15,000 babies.

Later this year, TSI plans to introduce an electronic device to aid non-oral, motor-impaired individuals in self-expression.

The new device, called the Autocom (AUTO-monitoring COMmunication board), is a microprocessor-based communication board housed in a wheelchair laptray configuration which allows the user to independently select, construct and display letters, words, symbols or phrases. The flexible nature of the unit's input and output modalities permits a wide range of severely disabled individuals to use the Autocom in a variety of ways.

The unit is accessed by a number of input modalities. Normal operation is by use of a hand-operated pointer magnet which is moved across the surface of the board, selects entries from a 128-choice vocabulary matrix and triggers magnetic reed switches housed within the system. Differing pointing capabilities are accommodated by individually programmable dwell-time and matrix size for vocabulary selection. For people who do not have specific pointing capability, or for whom change of motion is limited, other input channels are provided.

There are also a number of output modes available to the Autocom user. A 32-character LED display allows review of the most recent string of vocabulary choices and permits easy editing of messages. Another 23-character optional LED display allows face-to-face conversation with the message recipient. Additionally, there is a 28-character-per-line printer which prints a permanent copy on paper.

The Autocom may be used to drive an electric typewriter or teletypewriter for telephone communications, interface as a computer terminal or potentially operate wheelchair or environmental controls.☐

By Betsy Gilbert, Staff Reporter

AJA's Small Business Software Turns Your TRS-80 Into A Real Workhorse

By the Interface Age Staff

When Radio Shack first introduced the TRS-80 Model I almost two years ago, they probably did not realize the amount of support that would be given to it by innovative entrepreneurs.

Probably the most exciting and innovative software has been in the area of small business; the grey area in small systems computing that everyone talks about but few do anything about. However, AJA Software, a small Orange, California company under the direction of Richard Lemon, has not wasted time talking about what could be done.

AJA has come as close as a company can in creating real magic for the versatile Radio Shack machine. They have developed programs for Accounts Receivable, Payable, Word Processing, Payroll, Letter Writing, Inventory Control and even a special program for INTERFACE AGE which keeps track of students and their grades.

Not only has AJA developed these so-called standard programs, but in the process has created a number of useful programmer utilities for doing number conversions, listing multiple programs, copying disk to disk and other useful routines that are used in-house and currently are not available for sale.

WHAT MAKES AJA UNIQUE

The one thing that makes AJA software unique in relationship to other similar software is that it is extremely well designed to work within the constraints of the TRS-80 system. Most importantly, the software works as advertised and is constructed in such a manner to give the user the maximum amount of data storage possible on the single density 5.25-inch diskettes.

Another exciting aspect of the software is the use of HELP messages to guide the user through the application and to explain how the software works. Figure 1 shows a partial example of the HELP message. The HELP message is one of the most important human engineering techniques to be employed in application software. Lemon and Chief Programmer Craig Jones handle the concept extremely well.

The internal constructs of the application use the tried and true methods of calculations for figuring dates, updating aging records and applying cash. All this comes from Lemon's several years experience in the DP industry, along with many hours of research and Jones' ability to work with numbers and complex equations.

THE SOFTWARE IN A NUTSHELL

To really understand and appreciate the software from AJA you have to try it. With prices in the $35 to $250 range, you can't go wrong for the cost.

The software is designed to be as user or human engineered as possible. The two designers use the MENU concept throughout all the applications, to allow the user to pick specific functions. In some cases the master menu causes the system to display still another submenu to break the possible choices down even further.

As much of the main system functions, such as date, time, and all disk I/O are made transparent to the user so that confusion is eliminated.

Continuous updates to the software are being made and current users are provided with the patches or fixes. These patches, however, do not in most cases represent fixes to 'bugs' but are enhancements to the application. Both Lemon and Jones feel that as purveyors of application software, it is their duty to provide updates to current users — an unusual approach. But they feel it works well for them.

One area where AJA admits to being a little lax in is error trapping, but as more and more units are finding their way into users' hands, error routines are being designed that handle the most frequent errors. This is not to say that the application software is not thoroughly tested before it is released. AJA software probably undergoes the most extensive and complete testing of any application software on the micro market today.

This testing comes from Lemon's long DP experience and as a result extensive test scripts are written to ensure adequate massaging of the application. Also Functional Problem Logs are kept on each problem either found in testing or user reported, so that adequate documentation is kept on each and every function of the application.

SPEAKING OF FUNCTIONS

The design of the software from AJA is modular in concept. A directory of the functional programs is found on a disk. This means that each function is built debugged and links to the rest of the application tested on a modular basis — again ensuring only the most functional of software design.

Should all of this excite you, what's even more interesting is that Dick Lemon not only sells software, but answers questions about the working of the TRS-80. If you have a need for software or a quick question, write or call Richard Lemon or Craig Jones, AJA Software, P.O. Box 2528, Orange, CA 92669, (714) 774-1270.□

```
ACCOUNTS PAYABLE - INSTRUCTIONS FOR USE
1. TO CREATE A NEW ACCOUNTS PAYABLE DATA DISK USE THE
   "FORMAT" DOS UTILITY WITH A NEW OR BULK ERASED DISKETTE.
   NOTE: THE PROGRAM DISKETTE CONTAINS A LEVEL 2.1 DOS.
2. THE PROGRAM DISKETTE CAN BE LOADED IN ANY DRIVE; HOWEVER,
   THE DATA DISK MUST BE IN DRIVE #1. (REMEMBER, THERE MUST
   BE A DOS IN DRIVE #0.)
3. TYPE 'BASIC' (IF NOT ALREADY IN DISK BASIC MODE) ANSWERING
   'HOW MANY FILES?' AND 'MEMORY SIZE?' WITH <ENTER>.
4. NOW TYPE 'RUN "AP"' TO USE THE ACCOUNTS PAYABLE PACKAGE.
  NOTE: BEFORE TYPING 'BASIC' (WHILE STILL IN DOS LEVEL) YOU
        CAN TYPE 'AUTO APAUTO'. AFTER THIS STEPS 2-4 (ABOVE)
        WILL BE AUTOMATIC UPON PRESSING THE RESET BUTTON (OR
        POWER-UP). (SEE THE DOS MANUAL FOR DETAILS ON 'AUTO'.)
   AT THIS POINT YOU HAVE ACCESS TO EACH OF THE PROGRAMS
   IN THE ACCOUNTS PAYABLE SYSTEM. THEY ARE AS FOLLOWS:
OPT# NAME     PURPOSE - NOTES
---- -------- ----------------------------------------------
     AP       MASTER CONTROL PROGRAM - GIVES ACCESS TO THE
              OTHER PROGRAMS IN THE SYSTEM.
1    MMAINT   VENDOR MASTER MAINTENANCE - UPDATES THE
              VENDMAST FILE (ADDITIONS, DELETIONS, CORRECTIONS)
2    IMAINT   INVOICE FILE MAINTENANCE - ENTERS AND CORRECTS
              INVOICE DATA
3    CMAINT   CASH FILE MAINTENANCE - UPDATES RECORDS OF CASH
              PAYMENTS
4    MLIST    VENDOR MASTER FILE ROSTER LISTING
5    ILIST    INVOICE FILE ROSTER LISTING
6    CLIST    CASH FILE ROSTER LISTING
7    CAPPLY   APPLIES THE CASH PAYMENTS TO THE INVOICES.
8    CCLEAR   CLEARS THE CASH AND INVOICE FILES OF PAID ENTRIES
9    LABELS   PRINTS A SET OF MAILING LABELS TO THE PRINTER
10   PURGE    PURGES SELECTED DATA FILES
11   TWEAK    TWEAKS PARAMETERS FOR THE VARIOUS PROGRAMS
12   HELP     LIST THESE INSTRUCTIONS.
13   LHELP    PRINT THESE INSTRUCTIONS.
-- DATA FILE SPECIFICATIONS --
NAME       LOCATION     DESCRIPTION
---------- ------------ ------------------------------------
VENDMAST   DATA DISK    VENDOR MASTER DATA FILE (RANDOM - 2
                        VENDORS PER RECORD - 658 MAXIMUM *)
INVOICE    DATA DISK    INVOICE DATA FILE (RANDOM - 6 INVOICES
                        PER RECORD - 1974 MAXIMUM *)
CASH       DATA DISK    CASH RECEIPTS DATA FILE (RANDOM -
                        9 PAYMENTS PER RECORD)
PARAM      PROGRAM DISK USER'S PARAMETER STORAGE
INSTRUCT/A PROGRAM DISK THIS TEXT
* THESE MAXIMUMS ASSUME THAT A COMPLETE DISKETTE IS DEDICATED
  TO EACH DATA FILE, WHILE FOR MOST APPLICATIONS ONLY ONE
  DISKETTE IS REQUIRED.
-- DETAILS --
```

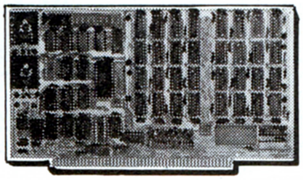
Figure 1.

6800, 64K BYTE RAM AND CONTROLLER SET

MAKE 64K BYTE MEMORY FOR YOUR 6800 OR 6502. THIS CHIP SET INCLUDES:
- 32 M5K 4116-3 16KX1, 200 NSEC RAMS.
- 1 MC3480 MEMORY CONTROLLER.
- 1 MC3242A MEMORY ADDRESS MULTIPLEXER AND COUNTER.
- DATA AND APPLICATION SHEETS. PARTS TESTED AND GUARANTEED.

$295.00 PER SET

S-100 **FULLY ASSEMBLED MOTHERBOARDS— FULLY SOCKETED, INDUSTRIAL GRADE**
- 8 SLOT ASSEMBLED **$149.00**
- 19 SLOT ASSEMBLED **$199.00**



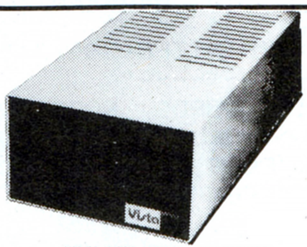
64K BYTE EXPANDABLE RAM

DYNAMIC RAM WITH ON BOARD TRANSPARENT REFRESH GUARANTEED TO OPERATE IN NORTHSTAR, CROMEMCO, VECTOR GRAPHICS, SOL, AND OTHER 8080 OR Z-80 BASED S100 SYSTEMS ★ 4MHZ Z-80 WITH NO WAIT STATES.
- SELECTABLE AND DESELECTABLE IN 4K INCREMENTS ON 4K ADDRESS BOUNDARIES.
- LOW POWER—8 WATTS MAXIMUM.
- 200NSEC 4116 RAMS.
- FULL DOCUMENTATION.
- ASSEMBLED AND TESTED BOARDS ARE GUARANTEED FOR ONE YEAR AND PURCHASE PRICE IS FULLY REFUNDABLE IF BOARD IS RETURNED UNDAMAGED WITHIN 14 DAYS.

	ASSEMBLED / TESTED	KIT
64KRAM	$595.00	$565.00
48K RAM	$529.00	$499.00
32K RAM	$459.00	$429.00
16K RAM	$389.00	$359.00
WITHOUT RAM CHIPS	$319.00	$289.00

EPROM

2716-450NSEC **$49.00**



VISTA V-200 MINI-FLOPPY SYSTEM
- S100 DOUBLE DENSITY CONTROLLER
- 204 KBYTE CAPACITY FLOPPY DISK DRIVE WITH CASE & POWER SUPPLY
- MODIFIED CPM OPERATING SYSTEM WITH EXTENDED BASIC

$695.00
- EXTRA DRIVE, CASE & POWER SUPPLY

$395.00

16K X 1 DYNAMIC RAM

THE MK4116-3 IS A 16,384 BIT HIGH SPEED NMOS, DYNAMIC RAM. THEY ARE EQUIVALENT TO THE MOSTEK, TEXAS INSTRUMENTS, OR MOTOROLA 4116-3.
- 200 NSEC ACCESS TIME, 375 NSEC CYCLE TIME.
- 16 PIN TTL COMPATIBLE.
- BURNED IN AND FULLY TESTED.
- PARTS REPLACEMENT GUARANTEED FOR ONE YEAR.

$9.50 EACH IN QUANTITIES OF 8

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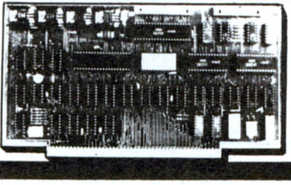
ORANGE, CALIFORNIA 92665
(714) 633-7280



MOTOROLA MEMORY ADDRESS MULTIPLEXER— MC 3242A

THE MC 3242A IS AN ADDRESS MULTIPLEXER AND REFRESH COUNTER FOR 16 PIN, 16K DYNAMIC RAMS THAT REQUIRE A 128 CYCLE REFRESH.
- CONTAINS MEMORY REFRESH COUNTER.
- MULTIPLEXES SYSTEM 14 BIT ADDRESS TO THE 7 ADDRESS PINS OF THE RAMS.
- COMPATIBLE WITH 3480 MEMORY CONTROLLER.
- PART IS GUARANTEED.

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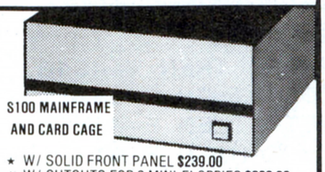
MOTOROLA DYNAMIC MEMORY CONTROLLER-MC3480L

MEMORY CONTROLLER DESIGNED TO SIMPLIFY CONTROL OF 16 PIN 4K OR 16K DYNAMIC RAMS.
- GENERATES RAS/CAS AND REFRESH TIMING SIGNALS FOR 16K TO 64K BYTE MEMORIES.
- GENERATES MEMORY READ/WRITE TIMING.
- DIRECT INTERFACE WITH MOTOROLA OR INTEL 3242A ADDRESS MUX AND REFRESH COUNTER.
- PART GUARANTEED.

$13.95 EACH



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- 2 SERIAL PORTS
- 2 PARALLEL PORTS
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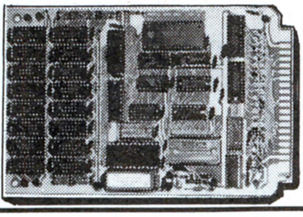
- POWER ON JUMP TO ON BOARD 2708 OR 2716 EPROM (BOARD DELIVERED WITHOUT EPROM

$325.00

KIM/SYM/AIM-65—32K EXPANDABLE RAM

DYNAMIC RAM WITH ON BOARD TRANSPARANT REFRESH THAT IS COMPATIBLE WITH KIM/SYM/AIM-65 AND OTHER 6502 BASED MICROCOMPUTERS
- PLUG COMPATIBLE WITH KIM/SYM/AIM-65. MAY BE CONNECTED TO PET USING ADAPTOR CABLE. SS44-E BUS EDGE CONNECTOR.
- USES +5V ONLY (SUPPLIED FROM HOST COMPUTER BUS). 4 WATTS MAXIMUM.
- BOARD ADDRESSABLE IN 4K BYTE BLOCKS WHICH CAN BE INDEPENDENTLY PLACED ON 4K BYTE BOUNDARIES ANYWHERE IN A 64K BYTE ADDRESS SPACE.
- BUS BUFFERED WITH 1 LS TTL LOAD.
- 200NSEC 4116 RAMS.
- FULL DOCUMENTATION
- ASSEMBLED AND TESTED BOARDS ARE GUARANTEED FOR ONE YEAR, AND PURCHASE PRICE IS FULLY REFUNDABLE IF BOARD IS RETURNED UNDAMAGED WITHIN 14 DAYS.

	ASSEMBLED / TESTED	KIT
WITH 32K RAM	$449.00	$419.00
WITH 16K RAM	$379.00	$349.00
WITHOUT RAM CHIPS	$309.00	$279.00



TRS-80 16K MEMORY EXPANSION KIT

THIS KIT PROVIDES THE IC'S TO EXPAND THE TRS-80 MAINFRAME FROM 4K BYTES TO 16K BYTES OR MAY BE USED IN THE EXPANSION CHASSIS. THE KIT INCLUDES:
- 8 M5K 4116-3 16K X 1, 200 NSEC RAMS.
- 1 DIP PROGRAMMING SWITCH.
- 1 SET OF EASY TO FOLLOW INSTRUCTIONS THAT ONLY REQUIRES A SCREWDRIVER TO SUCCESSFULLY COMPLETE THE INSTALLATION.

$72.00 PER KIT

CIRCLE INQUIRY NO. 59

Changing Acres to Rods to Yards to . . .

The metric rush stumbles when American land measurement comes into the limelight. Everything aside, an acre is still as American as baseball. Which brings us to the problem of finding a dictionary every time the question arises as to how many feet, rods or yards are in an acre. Once the information is located, then the calculations must be done. Of course, that is before the microcomputer.

Since decades will pass before metrics become popular, this program may be helpful. It has been written so that conversion to other string handling BASICs is straightforward. The program assumes rectangular land measurements in feet, yards, or rods. Geometry buffs may want to expand the program to calculate semi-circles, trapezoids, or New Jersey.

After the program has been debugged, enter side "A" followed by a comma and the term "YARDS", "RODS" or "FEET". Next enter side "B" using the same measurement. Input is repeated and the acreage calculated.

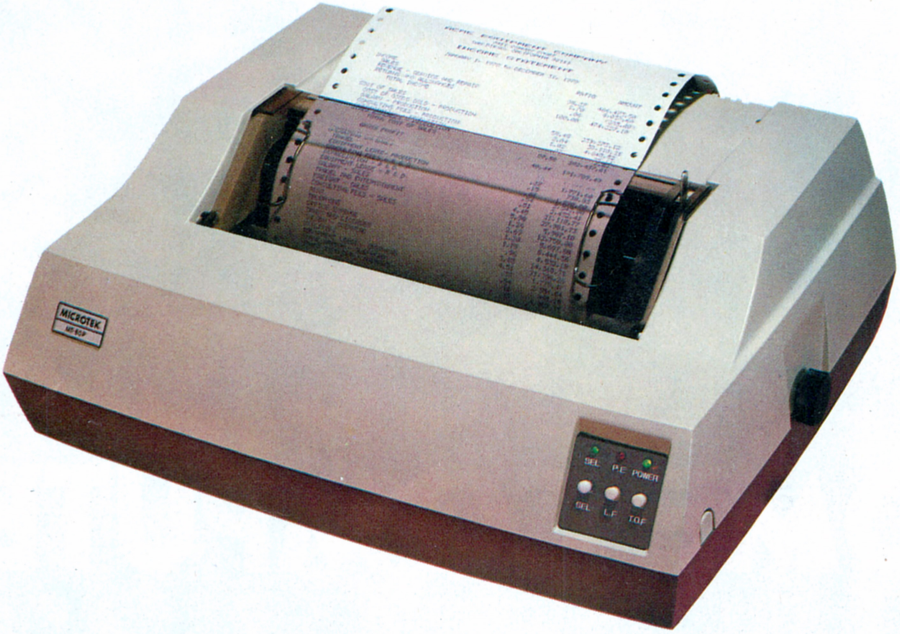
You may alter lines 100 and 770 to clear the screen of your CRT and home up according to your terminal's needs. These lines are currently set to use control Z and control B. A second option is to skip this sequence altogether if desired.

This short program may stand alone or be used as a subroutine within a larger BASIC program.☐

```
0100 FOR X9=1TO3:PRINTCHR$(26):NEXTX9:PRINTCHR$(2)
0110 LINE= 100:DIGITS=2
0200 PRINT TAB(23);"ACRE CACULATION"
0210 FOR X9=1TO64:PRINT"=";:NEXTX9:PRINT:PRINT
0220 FOR X9=1TO5:PRINT:NEXTX9
0230 PRINT TAB(5);"USING THE FOLLOWING DIAGRAM INSERT FIGURES:"
0240 PRINT
0250 PRINT TAB(15);"---------- A ----------"
0260 FOR X9=1TO2:PRINTTAB(15);"!";:PRINTTAB(38);"!":NEXTX9
0270 PRINT TAB(15);"B";:PRINTTAB(38);"!"
0280 FOR X9=1TO2:PRINTTAB(15);"!";:PRINTTAB(38);"!":NEXTX9
0290 PRINT TAB(15);"-----------------------"
0300 INPUT "ENTER FIGURE [A] STATING YARDS, RODS OR FEET: ",A,B$
0310 IF B$="YARDS" GOTO 340:IF B$<>"YARDS" GOTO 350
0320 IF B$="RODS" GOTO 340:IF B$<>"RODS" GOTO 360
0330 IF B$="FEET" GOTO 340:IF B$<>"FEET" GOTO 370
0335 GOTO 370
0340 GOTO 400
0350 GOTO 320
0360 GOTO 330
0370 PRINT TAB(5);"> ERROR IN INPUT. PLEASE RE-ENTER. ":GOTO 300
0400 INPUT "NEXT, ENTER FIGURE [B]",B
0410 LET A1=A*B
0420 LET Y=1:R=1:F=1
0500 IF B$="YARDS" THEN Y=4840
0510 IF B$="RODS" THEN R=160
0520 IF B$="FEET" THEN F=43560
0600 LET Y=A1/Y:R=A1/R:F=A1/F:PRINT
0710 PRINT TAB(10);"SIDE [A] BEING ";A;" ";B$;" AND SIDE [B]"
0720 PRINT TAB(10);"BEING ";B;" ";B$;" TOTAL ACRES = ";
0730 IF B$="YARDS" THEN PRINT TAB(22);Y
0740 IF B$="RODS" THEN PRINT TAB(22);R
0750 IF B$="FEET"THEN PRINT TAB(22);F
0760 PRINT :INPUT"FOR ANOTHER CACULATION PRESS RETURN",X$
0770 FOR X9=1TO3:PRINTCHR$(26):NEXTX9:PRINTCHR$(2)
0780 GOTO 220
0800 END
```

By Jim Schreier, Associate Editor

What makes the Microtek Printer so different? Nothing!



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Add $15.00 for packaging & shipping. Dealer inquiries invited. California residents add 6% sales tax.

THE TI-99/4 HOME COMPUTER

Texas Instruments' Answer to Tom Swift's Wonderful Magic Machine

By Carl Warren

Imagine the idea of going to your local computer store or electronics shop and purchasing a box that contains a computer. One which the salesman tells you doesn't require any special knowledge or sophisticated housing or even the requirement that you own a soldering iron.

Sound impossible? Maybe three years ago or even as recent as late '77 or early '78, the idea of buying a computer like an appliance was more than most computerists could possibly comprehend. The time has now come for that to happen, with the introduction of the long-awaited computer from Texas Instruments, the TI 99/4.

The tiny computer is housed in an eye-pleasing case that contains the keyboard, a slot for the special ROM program packages and a cassette interface. The rest of the system is made up of a 13-inch color monitor designed specifically for the 99/4 system, not just a modified television set.

The basic system also includes built-in, full floating point 13-digit expanded BASIC which meets current ANSI standards. An equation calculator is also part of the system software.

When the packing box is first opened, the new owner is immediately exposed to three important documents designed to enhance the use of the system.

The first document is a "read me first," written and illustrated in such a manner to make setting up the computer as goof proof as possible.

Next is found a book prepared by Bob Albrecht to help the novice computer user, *Beginners Guide to BASIC*. This book, like all Albrecht books, begins at the start of what you need to know and carries you on through the fascinating world of BASIC programming.

To round out the basic literature included with the machine is the "User's Reference Guide," which contains further advanced details on the TI BASIC, plus information on servicing and warranty — or answers to all those questions you didn't know to ask but need to.

TI has provided a tremendous amount of useful documentation with the basic machine, but they have not stopped there. Working with Herbert Peckham and McGraw-Hill, a more advanced BASIC programming book has been prepared. It will be available later this year.

INSIDE THE 99/4

The insides of the 99/4 are probably the most exciting aspect of the machine. Based around the powerful 9900 MPU, the system has available 16K of user accessible RAM and 26K ROM in the basic system.

The 99/4 is currently the only unit on the market that is fully shielded to prevent radiation. Also, to provide the clarity in the video display and to avoid possible FCC restrictions, TI elected to make the display monitor part of the total package.

The real secret of the system lies in the solid state software modules. These paks enhance the basic ROM and RAM that are inherent to the system by providing expansion up to 72K, and also serving as the container for high level programs.

Another built-in function of the tiny system supplies music and sound effects. They are generated by the handling of the output of the system. This of course means that some exciting games or applications can be created by the user, or supplied by TI on the software modules that bring the screen to life.

Speaking of bringing the screen to life, the system provides 16-color graphics capability, which gives the illusion of covering the entire gray scale and color spectrum. Due to the engineering that went into the graphics of the system, and the use of interrupts and DMA type processing, several functions appear to take place at the same time. Consequently, it is not unusual to hear the machine playing music and see several animated characters on the screen at the same time.

Statistics
Household Budget Management
Physical Fitness
Home Financial Decisions
Video Chess
Investment Analysis
Personal Record Keeping
Early Learning Fun
Number Magic
Beginning Grammar
Football

MORE ON THE SOFTWARE

Texas Instruments has developed a method of distributing consumer-oriented software on solid state modules. That is software designed to be used by anyone with or without an understanding of computers.

> **It is not unusual to hear the machine playing music and see several animated characters on the screen at the same time.**

Each module was designed after careful research into the game or working application to ensure that the computer would correctly handle user response and in all cases give the correct answers or perform the next function. Each module contains anywhere from one to several ROM chips that have been microprogrammed with the given application.

The solid state modules are not designed to be programmed by the user but are to provide them with high quality reliable software. The modules are planned to sell in the $20 to $70 price range, depending upon the application. To aid dealers who want to carry the system, TI offers a phone assistance service at (214) 234-0692.

According to company officials, the solid state approach was taken to give users value and reliability for their program purchases. Currently 15 modules are available from TI on applications ranging from football to statistics, with more planned for release early in 1980.

Because the TI 99/4 is designed not only to fit the average man's pocketbook — selling in the $1,000 range — but also provide computer power to non-computer people, TI teamed with one of the major game companies so all members of the family could use it. Milton Bradley has gone to great lengths to provide high level support for the machine in the form of games.

The games from Milton Bradley are adaptations of their famous tried and true board games of: YAHTZEE, HANGMAN, and CONNECT FOUR. They have also added a new game called ZEROZAP, which would never work well on a board but is exciting on a computer.

All the Milton Bradley games take advantage of the graphics and sound abilities of the 99/4 and as a result that spirit of excitement is further increased while playing the games.

Although Milton Bradley is only planning to market these games for the next several months, they are ready to release other exciting modules as the machine finds its way into the family circle.

Milton Bradley and Texas Instruments both view the 99/4 as the obvious extension of man's instinct to find new and different ways of entertainment. Because of this, both companies have and are expending a great deal of effort into the research needed to design popular software modules.

MORE ON THE HORIZON

There is even more to the 99/4 than high resolution graphics and exciting software packages. There is a voice. With TI's experience in the realm of speech synthesis, evidence Speak and Spell, it was only natural that their entry to the home computer market would have this ability.

This talking ability is based on the tone generation ability of the basic machine, plus the use of an add-on synthesizer that will have plug-in vocabulary modules. The idea is to

Gamevision CARTRIDGES by Milton Bradley
exclusively for the TEXAS INSTRUMENTS HOME COMPUTER
Featuring the exciting games of
• ZeroZap • Connect Four • HANGMAN • Yahtzee
ZeroZap
Yahtzee
HANGMAN
Connect Four

carry the human engineering of the system to the nth degree. Using the speech function of the system, a user can write a program that will not only display a question but ask it at the same time, eliciting both a visual and verbal response.

The possibilities based around these functions alone are endless and could quite conceivably open up a market for enterprising entrepreneurs who wish to service some sector of the handicapped populace.

To round out the system, TI is also planning a later introduction of an RS232 adaptor, disks and a printer. The remote control paddles are available now as system options.

MAKING IT WORK

The TI 99/4 has to be one of the most simplistic computers ever invented. All the user does is turn it on, insert a software module and tap a key on the keyboard. The machine responds with quick visual displays, or with music. In a few months voice will be added.

The user is led through every function that is available, both in the running application, and also through the supplied system documentation and module documents.

What makes the TI 99/4 really unique is that it was designed for functional purposes by some of the world's best electronic engineers, then designed for human operation by everyday folks.☐

Table 1. TI-99/4 Specifications

DISPLAY

13" Color monitor
16 Colors
5' Video/sound cable

CONSOLE

CPU: 9900 Family, 16-bit microprocessor, plus 256-byte scratchpad RAM.

Memory: Total combined memory capacity: 72K bytes. Internal ROM memory supplied: 256K bytes. External ROM memory: (Solid State Software™ Command Modules) Up to 30K bytes each. RAM memory supplied: 16K bytes.

Keyboard: 40-key staggered Qwerty, full travel. Overlay for second functions.

Sound: 5 octaves, 3 simultaneous tones plus noise generator. From 110 Hz to beyond 40,000 Hz.

Power: 110V, 60Hz, 20W. Wall mounted console transformer, UL listed 8' power cord.

I/O: Composite video and audio output for monitor. Interface for up to 2 audio cassettes. 44-pin peripheral connector — up to 3 peripherals attached to system. System memory and address signals available at peripheral connector. Mini-earphone jack. Remote control interface.

Built-in Software: 14K byte BASIC interpreter. Internal Graphics Language interpreter, not user accessible. Equation calculator. Internal 4.4K byte monitor, not user accessible.

Size: 25.9 x 38.1 x 7.1 cm (10.2 x 15.0 x 2.5 in.)

Weight: Less than 2.3 kg. (5 lbs.)

CONSOLE TECHNOLOGY (Detail Description)

CPU Chip (NMOS): TMS9900 16-bit microprocessor. Minicomputer instruction set including hardware multiply and divide. Architecture with 16 general registers. Can address up to 64K bytes of memory. 4 interrupt lines.

Video Display Processor Chip (NMOS): Controls display memory and generates composite video signal. 24 lines of 32 characters with 8x8 dot resolution. Provides sixteen colors: white, gray, magenta, light yellow, yellow, light red, medium red, dark red, cyan, light blue, blue, light green, medium green, dark green, black, transparent. Provides 32 sets of 8 characters each with different foreground/background colors. Addresses up to 16K bytes of RAM for CPU or display.

Sound Controller Chip (I^2L): 3 voices with 5 octave musical resolution. 15 bit programmable noise source. 100 mW audio drive with 30 db control in 2db steps.

Solid State Software Command Modules. Up to 30K bytes PMOS ROM. Up to 8K bytes NMOS ROM. Simple plug-in module.

PERIPHERALS

Remote Controls: 2 controllers. Cable: twin cable with single connector, 4' long. 8 direction control — up, down, left, right and diagonals. Fire button. Controls designed for use with either hand.

Solid State Speech™ Synthesizer. Uses Speak 'N Spell™ technology. Approx. 250 words in unit. Plug-in vocabulary expansion. Hundreds of words can be added. Interfaces via I/O port.

RS-232 Interface: Provides interface to RS-232 type computer peripherals such as printer, plotters, digitizers, D/A converters, terminals, and data tablets. Dual port, two standard DB-25 connectors.

Recorder Interface: 1 or 2 standard audio cassette units (not included) interface through a cassette interface. Cable: twin cable with single connector, 2' long. Each record recorded twice for 600 baud effective recording rate. Checksum added to end of each double recorded record. Operator interaction fully prompted. Provides mass non-volatile program/data memory storage.

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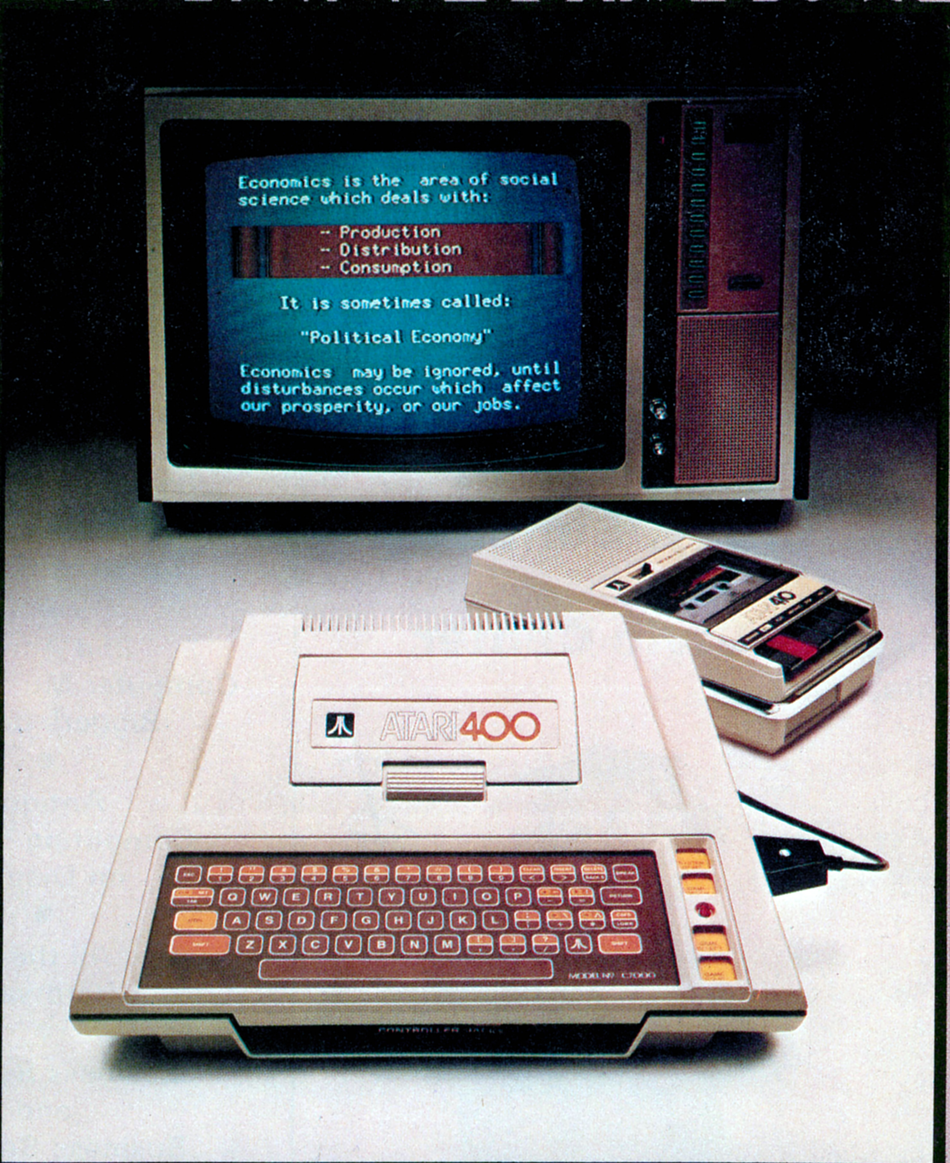


```
Economics is the  area of social
science which deals with:

          -- Production
          -- Distribution
          -- Consumption

      It is sometimes called:

        "Political Economy"

Economics  may be ignored, until
disturbances occur which  affect
our prosperity, or our jobs.
```

A TOOL FOR EDUCATION

By Don Inman

The barriers to the use of computers in our schools will finally come tumbling down as educators become familiar with the capabilities of the Atari 400 and 800 computers. Atari is providing features which make the computer a truly versatile and flexible tool which can easily be used by a non-technical person. These features will be especially significant to teachers who must quickly be "brought up to speed" in computer usage. This is necessary if our children are to receive the instruction needed to function capably in our computerized society.

What does Atari have that puts it one giant step in front of other computer manufacturers? Probably the most significant feature is the plug-in ROM cartridges which provide for easy, rapid change of programming languages and software application programs.

Atari provides a BASIC language cartridge, but the computer has the capability of accepting other languages as they are developed. Application software possibilities include entry by either a second plug-in ROM cartridge *or* conventional cassette tape. A disk drive is an available option which can also be used for software entry.

The plug-in cartridge will provide educators with the opportunity to teach their students a variety of programming languages as the cartridges are developed. The student will then be able to develop an ability to program, and to use programs, in several different languages. This is extremely important, since some things may be impossible to do in one language, but be very easy to do in another.

Old ideas about computer hardware usually frighten the non-technical person. In the past a maintenance technician was a necessary extension of the computer. However, today's small computers *should be* highly reliable machines. A teacher's time is limited, and there should be no need for a computer user's capabilities to include technical hardware knowledge and skill. The modular construction used today largely eliminates maintenance problems, but when needed a capable repair facility is usually within reach. With its cartridges plugged in, the Atari is easy to use — yet its capabilities are extensive.

What features should a computer have to satisfy a wide variety of needs? There are many schools and many "pioneering" teachers who are experimenting with the new breed of microcomputers. However, the range of possible educational applications has hardly been touched. The computer should be available to every person in our public schools from kindergarten through adult education. But it isn't.

Cost has always been a prohibitive factor in the past. But off-the-shelf, inexpensive computers with a built-in high-level language (usually BASIC) are readily available today. Atari has two models with suggested retail prices of $549.99 and $999.99. These prices are for the base units and assume that you will provide your own television or video monitor for output. This puts the price of a computer in the range of normal educational audio-visual machines.

Old ideas about computer applications still pervade. Many think of computers spitting out reams of printed paper — largely mathematical calculations. This is static information resulting from the solution of cold, technical questions that have little, or no, meaning for most of us. Today, the video display can present moving pictures that change shape and size, disappear and reappear — a whole new world of dynamic visual output is now possible. We *must* capitalize on this new capability. It can lift the computer out of the math and business classes, and put it into every classroom in the school — as it should be.

Atari responds to this need because of its several features. Different programs require different levels of graphic display resolution. Atari's BASIC allows you to select one of eight mixed (text/graphics) screen display modes. This enables you to choose one of several levels of resolution for your display. With its use of color and sound, a visual display can leap out at you and provide a relationship with the real world that is not possible with a black and white printed static display. The use of the video display is the key to future use of educational applications. The enhancement that color and sound add to a dynamic visual display provides a second and third dimension that open up a new world for educators.

Since most educators do not want to become programmers, provisions should be available for the use of prewritten educational software that can be readily inserted in the machine. Interchangeable ROM cartridges can also be used for this application. Professionally written educational programs can be provided in several high-level languages to "match" the language being used. The Atari computers have this capability. Atari has published a list of application cartridges and educational system cassette programs that are, or will be, available. From this list, one quickly draws the conclusion that educators will be supported by Atari software application packages.

One last feature that can't be ignored is the string of connectors on the front of the computer. They will take the Atari joysticks and paddles — promise of fun and recreation — to be integrated with educational applications for dynamic reaction programs. The possibilities are unlimited.

The combination of the many built-in features promises to make the Atari a "best buy" for educators. Below is a list of BASIC statements for the Atari machines, giving hints of possible applications.

GRAPHICS X — This statement is used to select one of 8 mixed (text/graphics) screen display modes and clears the screen. The graphics resolution is selected by parameter X (which may be any arithmetic expression whose value is an integer 0-7)

PLOT X,Y — This statement causes a single point to be plotted at X,Y (non-negative integers). The range of values used for X and Y depend upon the graphics mode being used.

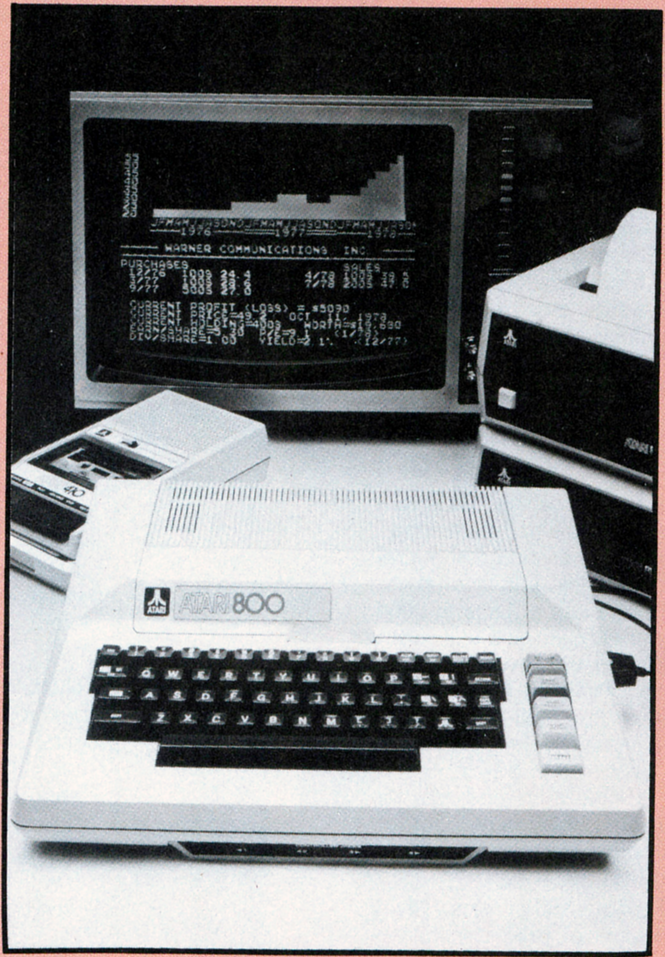
DRAWTO W,Z — This statement draws a line from the previous PLOT statement to the point W,Z. The values for W and Z again depend upon the display mode being used.

COLOR X — This statement selects a color register for PLOT and DRAWTO. X may be any integer 0-3.

SETCOLOR X,Y — This statement sets the selected color register for brightness and coloring. Values for X are integers 0-7 and for Y integers 0-15.

A sample program using the above:

10 GRAPHICS 5	would select screen mode 5 which is a graphics grid 80 x 40 with a text window at the bottom of the screen — would also clear the screen
20 COLOR 0	would select color register 0
30 SETCOLOR 0,6	would select a purple-blue color for graphics



40 PLOT 0,0	would plot a purple-blue colored point in the upper left corner of the screen
50 DRAWTO 80,40	would draw a purple-blue line from the upper left to the lower right corner of the screen

SOUND W,X,Y,Z — sets the sound registers for note, tone and volume
W selects voice registers 0-3 (integers)
X selects notes 0-255 (integers)
Y selects tones 0-15 (integers)
Z selects volume 0-15 (integers)

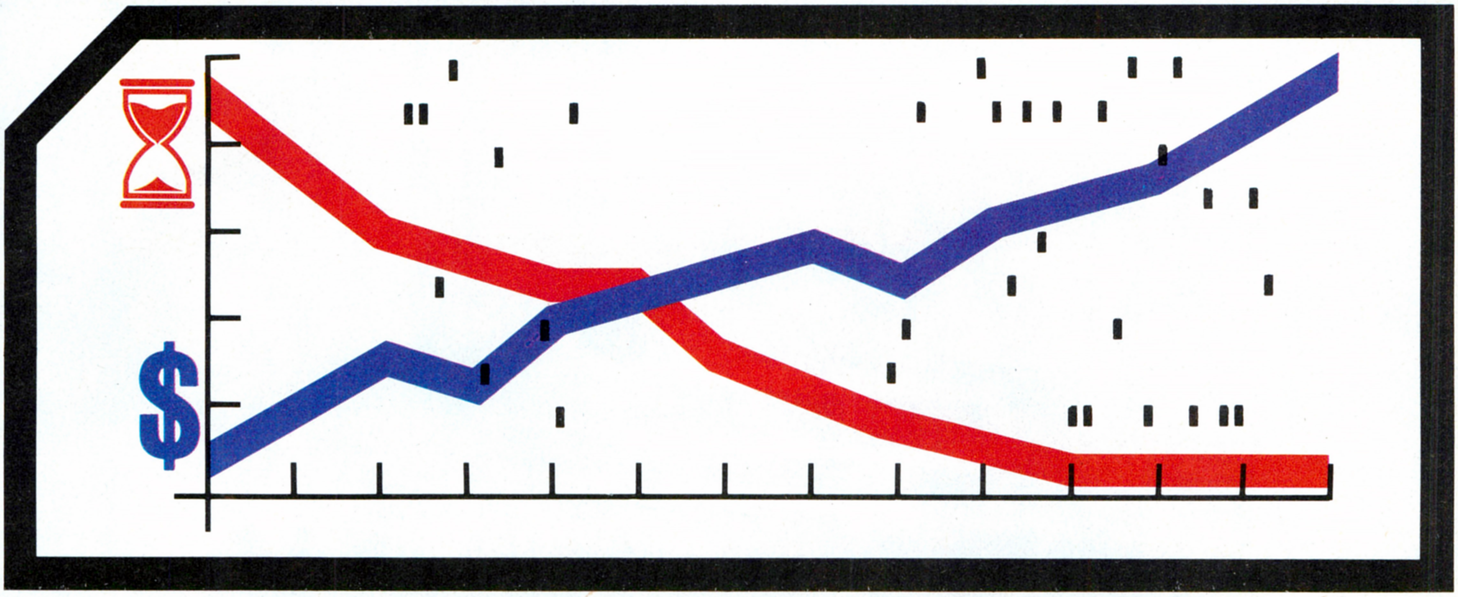
A sample program using sound:

```
100  FOR N = 0 TO 255
110  SOUND, 0,N,10,8
120  FOR W = 1 TO 50: NEXT W
130  NEXT N
```

This loop would play 256 successive notes with tone = 10 and volume = 8 through voice 0 — some would be out of your hearing range.

PADDLE (X)	— This statement returns the setting (0-255) of the paddle specified by X. X is the paddle number (0-3).
PTRIG (X)	— This statement returns the status (0=OFF, 1=ON) of the paddle trigger specified by X. X again is the paddle number (0-3).
STICK (X)	— This statement returns the setting (0-15) of the joystick specified by X. X is the joystick number (0-3).
STRIG (X)	— This statement returns the status (0=OFF, 1=ON) of the joystick trigger specified by X. X is the joystick number (0-3).☐

REAL ESTATE SOFTWARE



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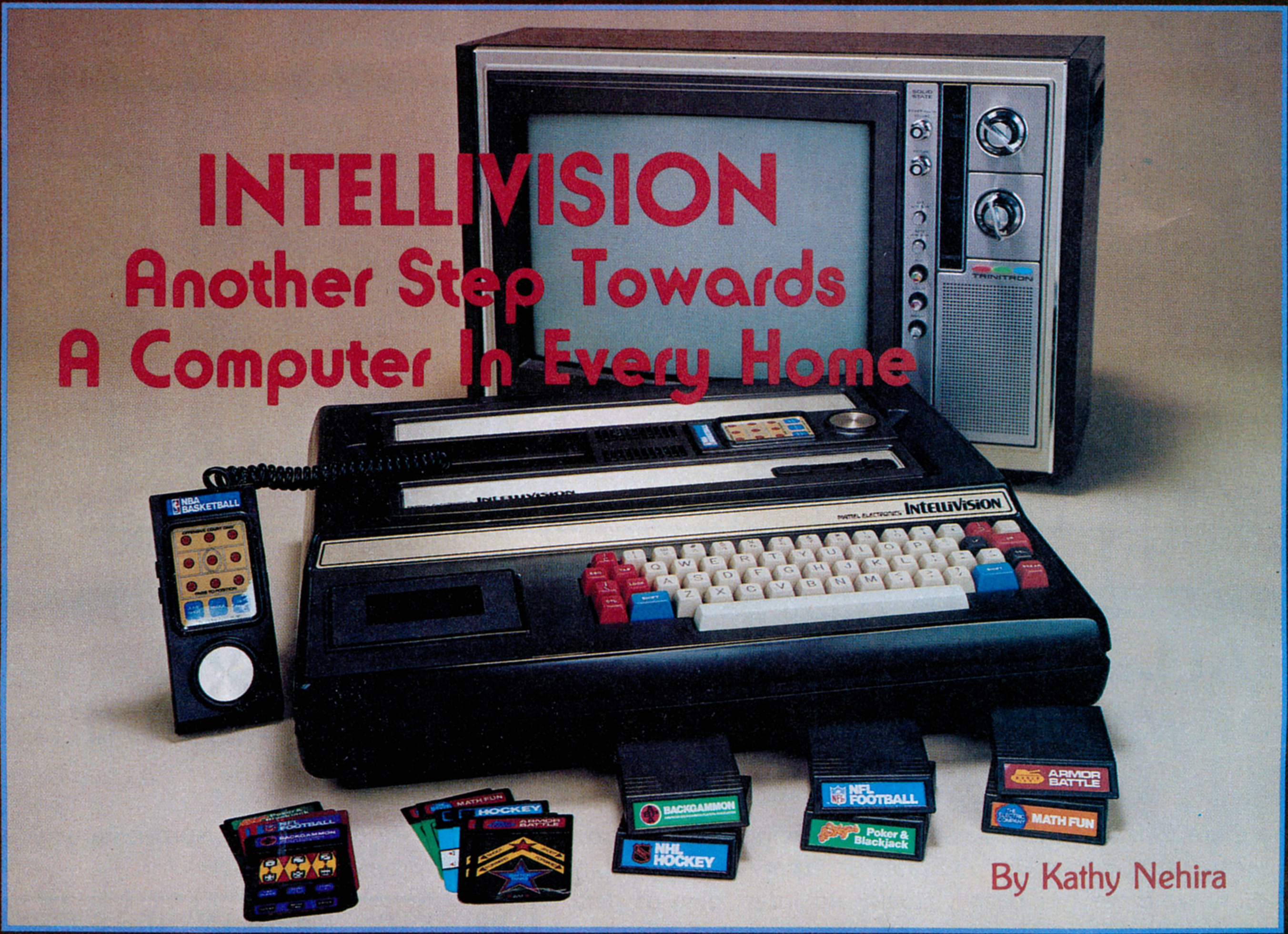


By Kathy Nehira

The impact of the computer is causing people both in and outside the industry to realize that a computer is not just developed for businessmen or programmers, but it can and should be used by everyone. Manufacturers are expounding on this fact as they develop more systems geared toward the home, where every member of the family — from preschoolers to parents — can use it.

Mattel Electronics is one company reaching towards the futuristic dream of every household equipped with a computer. They have developed a new home and game computer system, Intellivision, which they consider to be one of the first of its kind to reach the mass market.

Intellivision, which consists of two modularized hardware components and a wide range of software, hooks up to a standard television set (Photo 1).

The master component which came out last month, and the keyboard component which will be out in October, will each sell for approximately $250. The whole system will be marketed with a multi-million dollar advertising campaign this fall, right before Christmas.

The master component, which uses plug-in ROM cartridges, permits the consumer to play a variety of video games and become involved in a series of educational programs. Inside, the master component is a 16-bit microprocessor. A wide range of simulated sound effects, including three-part harmony music, should brighten game playing.

One of the reasons for taking advantage of the 16-bit technology was to provide high-quality, full color graphics. A broad color spectrum and a high degree of resolution makes the characters in the games more lifelike, and their moves more fluid. Creating graphics that would take full advantage of color TVs was an important consideration.

When the keyboard component is added to the system, the operators can use all the features of entertainment and game play *plus* the added feature of personal home computer applications.

The keyboard is a 64-key typewriter-like board with micropressure control for data input. This component also contains a tape cassette drive mechanism constructed to accept pre-programmed tapes, which give digital audio output as well as input. A microphone is included in order to deliver audio input for those programs which feature it.

When one purchases a master controller, he may do so without purchasing the keyboard component. But the keyboard component cannot function without the master controller; therefore if the keyboard is bought first, the consumer would have to purchase both components.

Edward Krakauer, Senior Vice President and General Manager of Mattel Electronics, claims that there are several differences between the Intellivision and other systems on the market.

"The first difference," he says, "is the fact that the system comes in component form. Usually the whole system must be purchased at a relatively high price. There is only one other system I know of that sells the components separately."

"We don't think that most families are ready for a $500, one-shot investment, so we are offering them the chance to get started with just one component and then expand when they think they can," explains Jeffrey Rochlis, President of Mattel Electronics.

Rochlis draws an analogy that Intellivision can be purchased like a stereo system. Stereos come in component form, such as the receiver or amplifier, turntable, tapedeck, and speakers. Consumers are able to purchase these separately, although the first component they would need in order for the system to work would be the amplifier, just as the master component would need to be purchased first for the home computer.

Another difference between the Intellivision and other systems, Krakauer says, is that no programming knowledge is needed. The system speaks to the operator in plain English, asking questions either verbally or via the screen. The operator in turn responds by either typing on the keyboard and/or speaking into a microphone.

Since no programming knowledge is needed, the entertainment or game-oriented software have been placed on ROM cartridges. Mattel considers the software to be one of the more unique qualities of the Intellivision.

"Most of the traditional games that are out on the market are very archaic; once you've played one, you've played them all," says Krakauer.

There will be 14 different game and educational cassettes available this year. The cassettes are arranged in network categories. The entertainment cartridge networks are: Sports, Action, Gaming, Strategy, and Children's Learning Fun.

Under the sports network there are six games. One, for example, is football, a full-length copy played in four 15-minute quarters. The user playing offense would actually handle the quarterback and act as coach. The defensive player can pursue the ball carrier to make a tackle or he can try to intercept a pass. There are 18 offensive and defensive plays taken from the National Football League playbooks (Photo 2).

To provide enough software packages to keep consumers from getting bored with the system due to limitations caused by the elimination of programming, Mattel is using both ROM cartridges and preprogrammed cassettes. After the Christmas buying season, persons who send in warranty cards will be mailed flyers detailing new developments in software packages for the system.

Hobbyists and those interested in developing their own programs will have to wait approximately a year. In 1980 there will be a BASIC and a Pascal cartridge available.

According to Krakauer, another unique quality of the Intellivision is a handheld disk controller for the master component instead of a joystick. Objects on the screen can be maneuvered in 16 different directions in a 360° manner by the object control disk pad.

Each controller features side mounted launch and fire buttons. There are two on each side, in order for a right- or left-handed person to easily play.

Also, on the controllers, an "overlay" system may be used instead of using a complicated book of instructions. Each game comes with printed overlays which fit directly over the keys on the controllers. Everything one needs to know about that individual game is printed on the overlay.

After a great deal of research, Mattel found that one area people were becoming concerned with was physical fitness. Their answer to this is a program in the Personal Improvement Network that resembles a television fitness show, but adds a personalized diet.

An instructor appears on the screen, first asking questions about size, age, desired weight, etc. After determining a complete program for the person, the taskmaster will lead the fitness buff through the jumping jacks, situps, and other exercises. As he counts the exercises off, a photo of an ice cream cone or other food disappears to show how many calories are being burned up.

The instructor also will prescribe a menu of 21 different meals, all nutritionally balanced and designed to cut down on calories. If there is a certain food the dieter dislikes, then he would tell the instructor by typing on the keyboard. The computer would then substitute that food with something that has equal nutritional and caloric value.

Unlike a TV personality, Intellivision's instructor adapts to the individual. If the user cannot meet the exercise requirements, the coach would scale down the number. If the operator does not like a certain exercise, such as situps, then the computer would give him another exercise to do which is equally as effective for the midsection.

For those more interested in developing their minds rather than their bodies, Intellivision offers a Self-Education Network. One program can teach the operator a foreign language in a relatively short period of time. Each of the magnetic tape cassettes features two audio and two digital tracks. One set is for prerecorded program content and the other set for the user to input whatever information is necessary.

The microphone and cassette program allows the person to hear and see the language as well as record his own voice. By using the microphone, the user is able to speak and compare his voice to the computer's.

THE MARKET

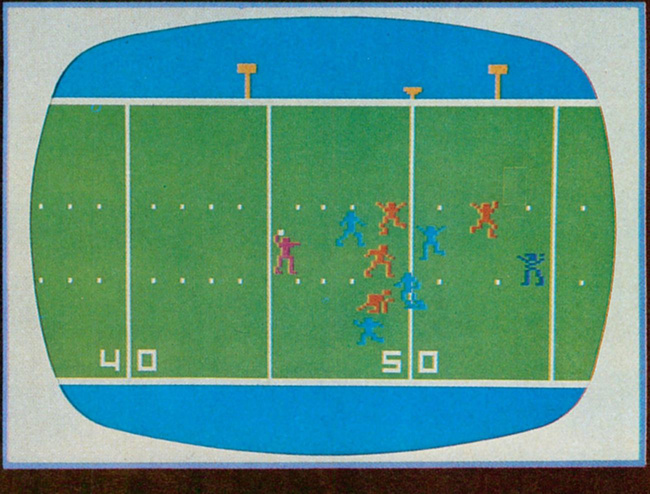
According to Krakauer, they expect the initial, primary consumers to be families with incomes of approximately $25,000 a year. By designing the software to meet the needs of each member of the family, the company is hoping it will enable the consumer to justify such an extravagant expense.

Rochlis thinks the father in the family will be the main purchaser. But in order to justify his $500 purchase, he will have to prove benefits for other family members. With the functions contained in the Intellivision he will easily be able to do this.

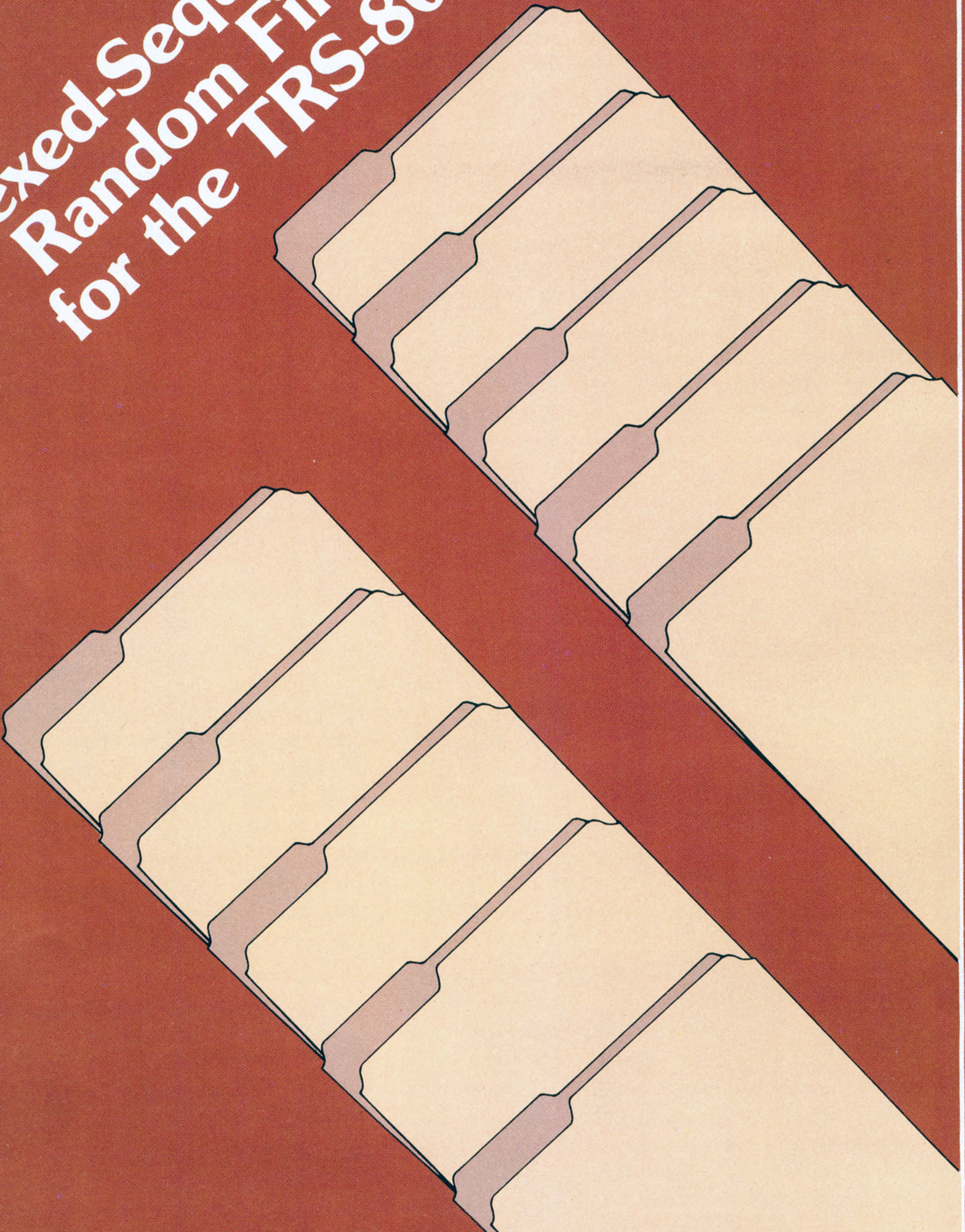
Mattel sees the Intellivision as a significant breakthrough towards tearing down the walls of fear many people have built up towards a computer-oriented society. The company projects that the home computer consumer will need approximately a three to five year educational time to give the consumer the opportunity to increase his awareness of home computers.

"As computers become more commonplace and prices come down, people will lose their fear of computers and instead see them as something they can use. Anybody can use systems such as the Intellivision and we feel that by 1985 it will have as much household penetration as the color television has today," says Krakauer.

Mattel feels that the home computers will be a long-term involvement where consumers and the electronic industry will gain worthwhile, valuable benefits. The prospects of a computer in every home grow rapidly every day and the Intellivision may very well be the beginning of a major breakthrough towards this idealistic dream.□



Indexed-Sequential Random Files for the TRS-80



By Phil Slaughter

Have you ever wished that you had an indexed-sequential file structure, in addition to the sequential and random access files on your micro's floppy disk system? With such a system, data items could always be retrieved in sequence (based on some key) in a minimum amount of time, no matter what order they were entered into the file. The following outlines the implementation of such a scheme on a TRS-80 system. However, any system with at least one mini-floppy disk drive could be used. Figure 1 represents the scheme used for the system.

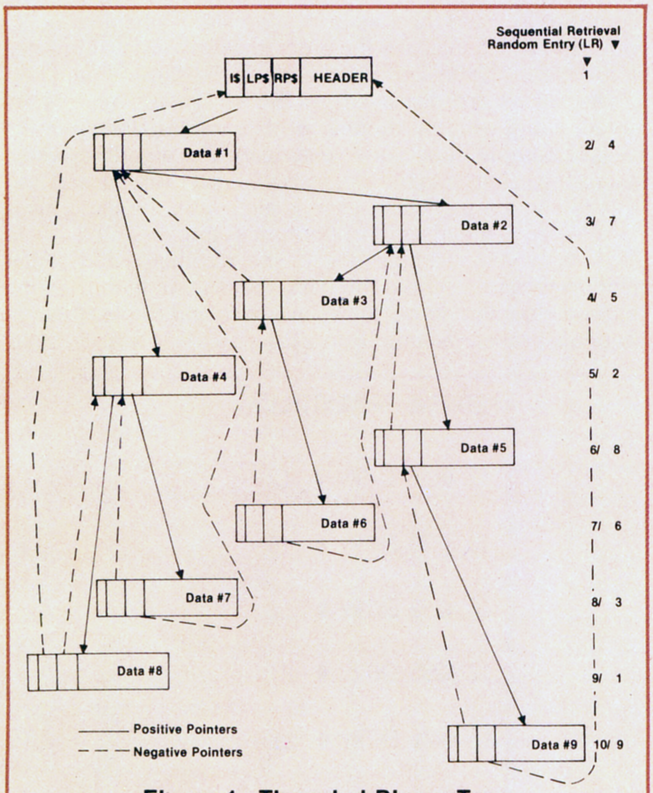


Figure 1. Threaded Binary Tree

The algorithms themselves require only about 800 bytes of RAM to implement in DISK BASIC, unless all of the data records are to be in memory at the same time. In this case, there should be enough additional RAM for this purpose. The programs (Listing 1) are designed for a file with a single key, (numeric in this case, but alphanumeric is possible too) with many entries.

These routines use only two pointers for accessing the keys. With these two pointers, it is possible to traverse the file in ascending or descending order from any point. With some modifications, it would be possible to adapt the algorithms to implement more than one key, with additional pointers, if that were needed in a particular application. This would be accomplished through the use of multiple pairs of pointers, one pair for each key. This would yield a multi-key file structure (Figure 2).

The algorithms[1] used to accomplish these tasks use a threaded binary tree structure. Several other structures were available and were considered for this project, but this one was selected.

The TRS-80 operating system (DOS VER 2.1) only allows data files to contain 329 physical records (PR's), each with 256 (255 usable) bytes of information, but each PR can be divided into more than one logical record (LR). In the example given, there are 10 LR's with 25 bytes of information in each PR. Five of these bytes are overhead required for the index structure. This configuration leads to 3290 LR's for the entire file or 3289 data records, with one HEADER record, which contains housekeeping information.

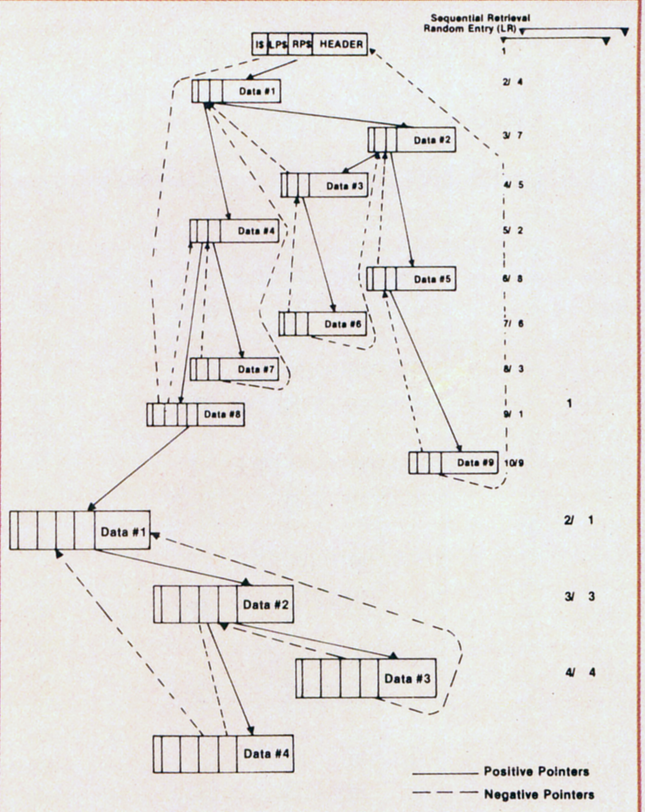


Figure 2. Multi-Tree File

Using the same number of overhead bytes but decreasing the data bytes gives a maximum number of LR's that can be stored in indexed-sequential form as 14,518, while increasing the number of bytes in the data field gives a minimum number of records to be 329. Of the five bytes of overhead, four are the actual pointers and the fifth is a "type" of data indicator. This byte can be set to indicate what "type" of data record is contained in the LR or that the data in the LR has been "marked" to be deleted. For example, if I$ = "I", then the data record is a new record, if I$ = "D", then the data record has been "marked" for deletion or if I$ = "6", for example, then the data is an "aged" record.

Since it is possible to have multiple LR's in each PR, (see Line 9210 for the definition of PR) it is also possible to insert and retrieve data without actually executing a GET or PUT statement each time data is accessed. Actual tests yield about 30% decrease in execution time when this fact is used. To implement this only requires that all LR's on a PR be read or written at one time, rather than each time a new LR is created or inserted. In this manner the disk need not be accessed again until data on a different PR is needed or until all of the LR's on a PR have been created or modified and are ready to be written.

ALGORITHMS

Initially the pointer locations in the first LR on the file should be set to zero, except for the first RP$ entry, which is set to two to indicate the next available LR. The algorithm uses this value to point to the next available LR at each step during an insertion and automatically maintains this value. By using this one preset value, it is not necessary to have a special routine to put the first LR into the file. If multiple keys and therefore multiple pointers are used, all additional pointer locations in each LR must be set to zero for the algorithm to work correctly.

```
      INITIALIZE DISK FILE FILENAME/DAT:0

      GENERATE RANDOM NUMBERS TO INSERT

  PUTTING NEW DATA ON DISK FILE - FILENAME/DAT:0


              TOTAL DATA ON FILE   0
              VALUE INSERTED  96.0283

              TOTAL DATA ON FILE   1
              VALUE INSERTED  48.9092

              TOTAL DATA ON FILE   2
              VALUE INSERTED  56.4142

              TOTAL DATA ON FILE   3
              VALUE INSERTED  95.2629

              TOTAL DATA ON FILE   4
              VALUE INSERTED  93.8904

              TOTAL DATA ON FILE   5
              VALUE INSERTED  39.8335

              TOTAL DATA ON FILE   6
              VALUE INSERTED  86.1913

              TOTAL DATA ON FILE   7
              VALUE INSERTED  17.1285

              TOTAL DATA ON FILE   8
              VALUE INSERTED  47.1405

              TOTAL DATA ON FILE   9
              VALUE INSERTED  95.5491

              TOTAL DATA ON FILE  10
              VALUE INSERTED  17.4471

              TOTAL DATA ON FILE  11
              VALUE INSERTED  13.0616

              TOTAL DATA ON FILE  12
              VALUE INSERTED  41.2529

              TOTAL DATA ON FILE  13
              VALUE INSERTED  90.6199

              TOTAL DATA ON FILE  14
              VALUE INSERTED  16.4292

              TOTAL DATA ON FILE  15
              VALUE INSERTED  15.3370
```

SAMPLE RUN 1

DRIVER ROUTINE

This routine defines what is needed for the insertion and retrieval algorithms to work. It defines things such as the number of LR's in a PR (LR%=9), the number of the first PR on the file (PR%=1), the retrieval error flag (E1%=0) and the retrieval entry flag (FR%=0) (see Table 1 for a complete list of variables and a definition of each).

In this example, the system random number generator defines the keys to be real numbers between 0.0 and 100.9999. This is done after the initial LR is initialized. The key generator is called in a FOR loop, which also calls the insertion algorithm to insert the values into the file. Alphanumeric information which indicates the order in which data was inserted in the file is also inserted in the file at the same time.

The values are displayed on the screen as they are inserted, along with the number of data entries already in the file (see Sample Run 1 for an example). The algorithm which inserts the values into the file, tests for a file overflow and also tests to see if a particular value is already in the file. This is not allowed in the insertion algorithm as implemented, but to allow this option simply delete line number 1231. After generating and inserting the data, the routine then uses the retrieval algorithm to get the values back and display them in sequential order (Sample Run 2).

```
RETRIEVE SEQUENTIALLY


 13.0616 ENTRY #  12

 15.3370 ENTRY #  16

 16.4292 ENTRY #  15

 17.1285 ENTRY #  8

 17.4471 ENTRY #  11

 39.8335 ENTRY #  6

 41.2529 ENTRY #  13

 47.1405 ENTRY #  9

 48.9092 ENTRY #  2

 56.4142 ENTRY #  3

 86.1913 ENTRY #  7

 90.6199 ENTRY #  14

 93.8904 ENTRY #  5

 95.2629 ENTRY #  4

 95.5491 ENTRY #  10

 96.0283 ENTRY #  1
```

SAMPLE RUN 2

ALGORITHM I

NAME		VALUE	DESCRIPTION
A$	=		Numeric information on file
B$	=		Alphanumeric information on file
CT%	=	CVI(RP$)	Value of the right pointer(RP)to the tree (current or next)
DN%	=	CVI(RP$)	Value of the right pointer(RP)to the tree
DR%	=	0	Flag indicating that it is not necessary to GET a new PR
	=	1	Flag indicating that is is necessary to GET a new PR
ER%	=	0	No error on insertion
	=	1	Value already on file on insertion
	=	2	Value found on retrieval
	=	3	Attempt to replace a deleted value (this is valid)
FG$	=	"IN"	Operation is an insertion
	=	"RE"	Operation is a retrieval
HP%	=		Flag used during insertion
I$	=	"D"	Indicates item marked for deletion
	=	"I"	Indicates item being inserted
IG$	=	"I"	Set to insert value in tree
L%	=		Value of current LR
LP$	=		The left pointer(LP)in the FIELD statement
LR%	=		Number of LR's in a PR less one (1)
LT%	=	UP%	Temp. variable for UP% - may point to next LR on left
N1%	=		Value of the subrecord to be written next on a PR
NM$	=		Alphanumeric information in a FIELD statement
NS%	=	N1%	Temp. variable for N1%
PP%	=	0	One of the flags indicating a new PR - used to select a PUT
	=	1	One of the flags indicating no new PR - used to bypass a PUT
PR%	=		Variable indicating current PR
PS%	=	PR%	Variable indicating previous PR - indicates GET new PR
QP%	=		Flag used during insertion - points to previous LR
RP$	=		The right pointer RP in the FIELD statement
RT%	=		Current total number of LR's on tree - or temp. variable on DN% - may point to next LR on right
SN!	=		Current value (numeric) to be inserted retrieved
TR%	=	RT%	Temp. variable for RT%
TS!	=		Value (numeric) of current key on tree
UP%	=	CVI(LP$)	Value of the left pointer(LP)to the tree
X$	=		Dummy buffer in FIELD statement
XP%	=	CT%	Last LR used in tree
ZP%	=	0	Indicates TS!≥SN!
	=	1	Indicates TS!≤SN!

ALGORITHM II

NAME		VALUE	DESCRIPTION
D1%	=	CVI(RP$)	Same as CT% or DN% in ALGORITHM I, but for next sequential entry
E1%	=	0	Indicates that the end of the sequential search of the tree not complete
	=	1	Indicates that the end of the sequential search of the tree is complete
FR%	=	0	Flag used to initialize values for retrieval algorithm
	=	1	Flag indicating that the initialization has been done
I1%	=		Current LR being searched in tree
IS%	=	CVI(LP$)	Same as UP% in ALGORITHM I, but for next sequential entry
J1%	=		Flag used by retrieval algorithm
U1%	=	CVI(LP$)	Same as UP% in ALGORITHM I

Table 1.

ALGORITHM I (Insertion/Retrieval)

1. GET* the first PR and within it the first LR, which is the HEADER record for the file. Use RP$ in this record as a pointer to the next available LR, for the first entry this will be 2. IF file is full THEN PRINT message, then RETURN ELSE.
2. IF this is the first entry into the file (i.e., both pointers at this level of the tree are zero (0); RP$ = 0 and LP$ = 0) THEN 8 ELSE
3. IF the key to be inserted/retrieved is greater than the current key in the file at this level THEN 7 ELSE
4. IF the key to be inserted/retrieved is less than the current key in the file at this level THEN 6 ELSE
5. IF the key is equal to the current key in the file at this level AND the operation is a retrieval THEN (success) RETURN ELSE IF it is equal AND it is an insertion THEN (error) RETURN ELSE
6. IF left pointer (LP$) is less than zero THEN 8 ELSE use LP$ to GET* the next entry in the tree, then GOTO 3
7. IF right pointer (RP$) is less than zero THEN 8 ELSE use RP$ to GET* the next entry in the tree, then GOTO 3
8. GET* pointer to the next available LR and save the current LP$ and RP$
9. IF this is the first entry in the file OR IF the key to be inserted is less than the current key THEN define LP$ ELSE define RP$
10. PUT* current record back on the file with new pointer
11. Define FIELD buffer values for the new entry (GOSUB 2000)
12. IF this is not the first entry THEN 8 ELSE set both pointers to point to the previous entry, then GOTO 15
13. IF key to be inserted is greater than current key THEN 14 ELSE define LP$ to point to the previous entry and RP$ as the pointer from the previous entry, then GOTO 15
14. Define LP$ as left pointer from previous entry and RP$ to point back to the previous entry
15. PUT* the current LR on the file, then RETURN.

The HEADER record contains a count of how many LR's are currently used. By calling the above routine several times, with different bytes defined as pointers each time, (LR$ and RP$ are different in each call to a FIELD statement) it is possible to create and access very complex multi-tree data files, where a data record in one tree is a HEADER for a totally separate tree.

In the algorithm above, the positive pointers point down to lower entries in the tree and the negative pointers point back up in the tree to previous entries (see Figure 1 again). The negative entries (threads) enable the tree to be traversed sequentially in either ascending or descending order.

ALGORITHM II (Retrieval)

1. IF this is the initial retrieval THEN GET* the HEADER record and follow its LP$ to the first data record. Define J% = 0 ELSE 5
2. IF the LP$ is less than zero THEN 3 ELSE follow the LP$ and GET* the next entry in the file, then GOTO 2
3. You have reached the next record in the file in ascending sequence. IF the RP$ points to the HEADER record THEN set E1% = 1
4. RETURN
5. GET* the ABS or RP$ and follow it to the next entry. If LP$ AND RP$ of previous entry are both less than zero THEN J% = 1
6. IF J% = 0 and LP$ of new entry greater than zero THEN 2 ELSE reset new pointers as old
7. If new LP$ AND RP$ are both greater than zero THEN J% = 0
8. If new LP$ AND RP$ are both less than zero THEN J% = 1
9. GOTO 3

If this routine is called with different pointers defined each time in the FIELD statement, then the user is able to retrieve very complex multi-tree file structures. Only the first algorithm may be used for insertion of data, but either algorithm may be used for retrieval, the selection being based on the sequence in which retrieval is desired.

When an item has been located in the file, it is possible to change any or all of the data within that LR (including the key, but not the pointers) or to change the "type" of data indicator or to "mark" a data item for deletion. If the key is changed, there is no guarantee that the data will still be in sequential order. If the pointers are changed, it is likely that it will not be possible to traverse the tree at all.

At some point, all of the logical records on a file will become filled with data, some "active" data and some "deleted" data. By using a combination of these two algorithms to alternately retrieve and insert data into a second file, the deleted records can be removed completely and the file repacked.

This proved to be an interesting project and was well worth the time spent to convert the algorithms to DISK BASIC for the TRS-80 and debug and test them. Both algorithms have been used with great success for some time and no errors have appeared.☐

Program follows

---

*In each of these cases, a GET or PUT is executed only when the associated PR changes.

REFERENCES

[1]Donald E. Knuth, *The Art of Computer Programming,* Vol. I, "Fundamental Algorithms," (305-345), Addison-Wesley, 1969.

PROGRAM LISTING

```
1 '************************************************************
2 'SIMPLE DRIVER ROUTINE                                        *
3 '************************************************************
5  CLS:CLEAR 300:DIM DN!(100):FG$="IN":FL$="FILENAME/DAT:0":OPEN"R",1,FL$:LR%=9:RP%=2:N1%=0:Q0$="DEMO PROGRAM":Q1$="INITIALIZE DISK
FILE "+FL$:Q2$="GENERATE RANDOM NUMBERS TO INSERT  ":Q3$="RETRIEVE SEQUENTIALLY":PR%=1:GET 1,PR%:ED%=20
10  Q4$="PUTTING NEW DATA ON DISK FILE - "+FL$:Q5$="SEARCHING FOR ":Q6$=" ON DISK FILE - "+FL$:Q7$="TOTAL DATA ON FILE ":Q8$="VALUE
INSERTED ":Q9$="AN ATTEMPT TO INSERT THIS DATA WOULD CREATE A DISK OVERFLOW:":R0$="INITIALIZE ANOTHER DISKETTE"
15  PRINT @26,Q0$:PRINT @143,Q1$
20  GOSUB 9220:IF N1%<>LR% THEN N1%=N1%+1:RSET I$="":RSET LP$=MKI$(0):RSET RP$=MKI$(RP%):RSET A$=MKS$(0.0):LSET B$=" ":RP%=0:GOTO 20
 ELSE PUT 1,PR%:PRINT @143,Q2$
25  FOR B%=0 TO ED%:DN!(B%)=RND(100)+RND(0):SN!=DN!(B%):ER%=0:GOSUB 330:NEXT B%:CLS:PRINT @26,Q0$:PRINT @149,Q3$:J%=0:E1%=0:FR%=0:PS
%=0:PR%=1:FG$="RE"
30  FOR B%=0 TO ED%:GOSUB 170:NEXT B%:END
130 '************************************************************
132 'GET DATA FROM FILE - ENORDER                                 *
134 '************************************************************
170  IF E1%<>1 THEN GOSUB 705:IF I$="D" THEN 170 ELSE GOSUB 3000:RETURN ELSE GOSUB 4000:RETURN
300 '************************************************************
302 'PUT A DATA RECORD ON THE FILE                                *
304 '************************************************************
330  PP%=1:IF FG$="IN" THEN PRINT @264,Q4$ ELSE PRINT @264,Q5$SN!Q6$
335 '
340 '    NOW GO SETUP FOR TREE INSERT/RETREIVAL
345      PS%=0:L%=1:QP%=1:HP%=1:DR%=1
350      PR%=1:GET 1,PR%:GOSUB 9210:ER%=0:TS!=0.001:RZ%=CVI(RP$)+1
355 '
360 '        FIND HEADER POINTER TO DATA TREE
365          RT%=CVS(A$)+1:IF RZ%>3289 THEN 420 ELSE PRINT @470,Q7$CVS(A$)TAB(63);:PRINT @597,Q8$SN!
375          TR%=RT%:UP%=CVI(LP$):IG$="I":LSET B$="HEADER":CT%=CVI(RP$):GOSUB 1030:HP%=QP%:IF ER%=2 THEN RETURN
380 '
385 '    NOW WRITE THE NEXT LR AVAILABLE OUT
405      L%=1:DR%=1:GOSUB 9210:RSET A$=MKS$(TR%):RSET RP$=MKI$(CT%):RSET I$="":IF ER%=1 OR ER%=3 THEN RSET A$=MKS$(CVS(A$)-1
407      PUT 1,PR%:RETURN
410 '
415 'ERROR MESSAGE
420  PRINT @834,Q9$:PRINT @916,R0$:B%=ED%:RETURN
690 '************************************************************
692 'FIND A RECORD - ENORDER                                      *
694 '************************************************************
705  IF FR%<>0 THEN 765 ELSE I1%=1:J1%=0:FR%=1
710 '
715 '    GO LEFT YOUNG MAN
720      L%=I1%:DR%=1:GOSUB 9210:U1%=CVI(LP$):IF U1%=0 THEN 800
725      I1%=U1%:IF U1%<0 THEN D1%=CVI(RP$):GOTO 745 ELSE 720
730 '
735 '        VISIT A NODE
745          IF D1%=-1 THEN E1%=1
750          RETURN
755 '
760 '    FOLLOW THE THREADS OR RIGHT LINKS
765      I1%=ABS(D1%):L%=I1%:DR%=1:GOSUB 9210:IS%=CVI(LP$)
770      IF U1%<0 AND D1%<0 THEN J1%=1
775      IF J1%=0 AND IS%>0 THEN I1%=IS%:GOTO 720 ELSE U1%=IS%:D1%=CVI(RP$)
780      IF U1%>0 AND D1%>0 THEN J1%=0
782      IF U1%<0 AND D1%<0 THEN J1%=1
785      GOTO 745
790 '
795 'ERROR
800  PRINT CHR$(10)TAB(6)"ERROR ON FILE-SORRY ABOUT THAT":E1%=1:RETURN
1000 '************************************************************
1002 'DRIVER FOR TREE BUILDER - READER                             *
1004 '************************************************************
1030  ZP%=0:IF UP%<>0 OR DN%<>0 THEN 1045 ELSE HP%=QP%+1:GOSUB 1095:RETURN
1045  L%=2:QP%=2:DR%=1:GOSUB 9210:UP%=CVI(LP$):DN%=CVI(RP$)
1049  TS!=CVS(A$):PP%=0:GOSUB 1225:IF ER%<>0 THEN RETURN ELSE GOSUB 1095:RETURN
1080 '************************************************************
1082 'INSERT - ONLY                                                *
1084 '************************************************************
1095  PP%=1:XP%=CT%:CT%=XP%+1:LT%=UP%:RT%=DN%:IF ZP%<>0 THEN 1115 ELSE RSET LP$=MKI$(XP%)
1100  RSET I$=IG$:L%=XP%:DR%=1:GOSUB 9210:GOSUB 2000:GOTO 1135
1105 '
1110 '    INSERT RIGHT LINK
1115      RSET RP$=MKI$(XP%):GOTO 1100
1125 '
1130 'IF NON-EMPTY - THREAD THE TREE-FIRST NODE BELOW HEADER
1135  IF LT%<>0 AND RT%<>0 THEN 1155
1140  RSET LP$=MKI$(-QP%):RSET RP$=MKI$(-QP%):GOTO 1180
1145 '
1150 '    LEFT NODES
1155      IF TS!<SN! THEN 1175
1160      RSET LP$=MKI$(LT%):RSET RP$=MKI$(-QP%):GOTO 1180
1165 '
1170 '    RIGHT NODES
1175      RSET LP$=MKI$(-QP%):RSET RP$=MKI$(RT%)
1180      QP%=XP%:RETURN
1200 '************************************************************
1202 'SEARCH TREE - CHILD - LEFT BRANCH                            *
1204 '************************************************************
1225  ZP%=0:IF TS!<SN! THEN ZP%=1:GOTO 1320
1230  IF TS!=SN! AND I$="D" THEN RSET I$="I":GOSUB 2000:ER%=3:PUT 1,PS%:RETURN
1232  IF TS!=SN! THEN IF FG$="IN" THEN ER%=1:RETURN ELSE ER%=2:RETURN
1235  IF UP%<=0 THEN RETURN
1245  QP%=UP%:L%=UP%:DR%=1:GOSUB 9210:UP%=CVI(LP$):DN%=CVI(RP$):TS!=CVS(A$):GOTO 1225
1300 '************************************************************
1302 'IS IT A BROTHER - RIGHT BRANCH                               *
1304 '************************************************************
1320  IF DN%<=0 THEN RETURN
1325  QP%=DN%:L%=DN%:DR%=1:GOSUB 9210:UP%=CVI(LP$):DN%=CVI(RP$):TS!=CVS(A$):GOTO 1225
1990 '************************************************************
1992 'PUT THE DATA INTO THE BUFFER ON INSERT                       *
1994 '************************************************************
2000  RSET A$=MKS$(SN!):LSET B$="ENTRY # "+STR$(B%+1):RETURN
3000  SN!=CVS(A$):NM$=B$:PRINT @278,SN!;NM$:RETURN
4000  PRINT @266,"LAST RECORD FOUND":RETURN
9190 '************************************************************
9192 'GET THE PROPER LR-PUT WHEN NECESSARY                         *
9194 '************************************************************
9210  PR%=INT((L%-1)/(LR%+1))+1:N1%=L%-(LR%+1)*INT((L%-1)/(LR%+1))-1
9212  IF DR%=0 OR PS%=PR% THEN 9220
9213  IF FG$="IN" AND PS%<>0 AND PP%<>0 THEN PUT 1,PS%
9214  NS%=N1%:GOSUB 10015:PS%=PR%:N1%=NS%
9220  FIELD 1,N1%*25AS X$,1AS I$,2AS LP$,2AS RP$,4AS A$,16AS B$:RETURN
10000 '************************************************************
10002 'GET ENTIRE PR                                               *
10004 '************************************************************
10015  GET 1,PR%: FOR N1%=0 TO LR%:GOSUB 9220:NEXT N1%:RETURN
```

Software for most popular 8080/Z80 computer disk systems including ***NORTH STAR, MICROPOLIS, iCOM, SD SYSTEMS, DYNABYTE DB8/2, ALTAIR, EXIDY SORCERER, VECTOR MZ, 8″ IBM, HEATH H17*** *&* ***H89, HELIOS, IMSAI VDP42*** *&* ***44, REX*** *and* ***OHIO SCIENTIFIC*** *formats.*

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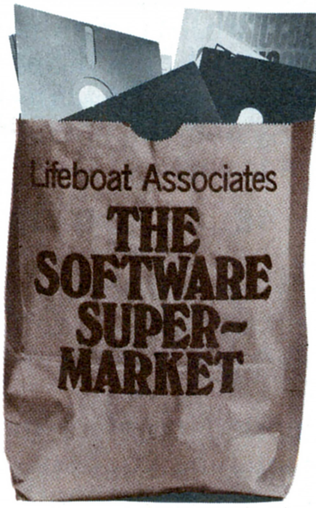

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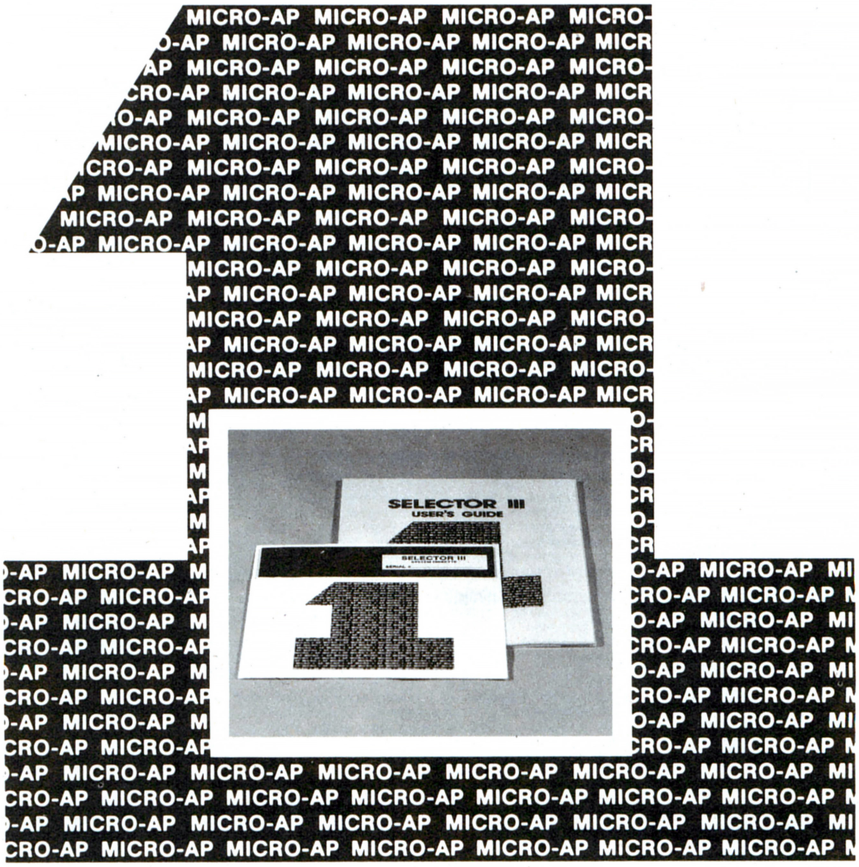

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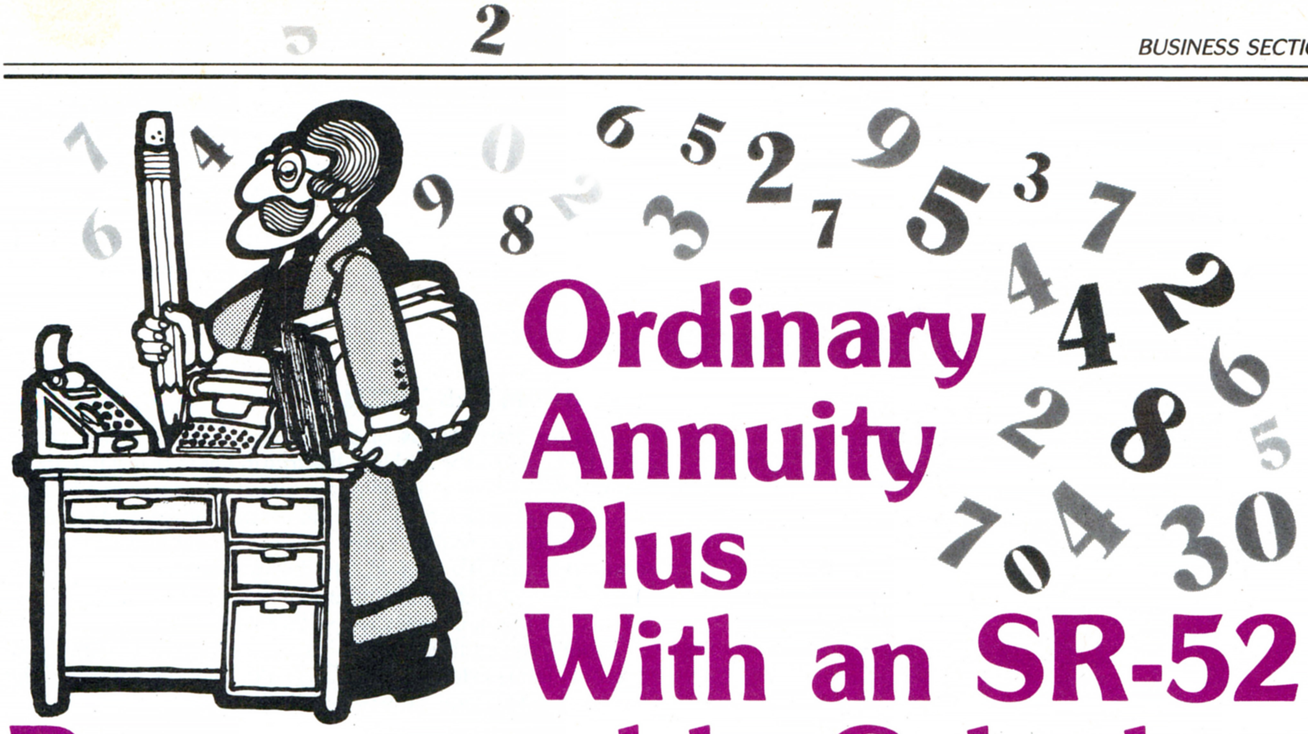

Ordinary Annuity Plus With an SR-52 Programmable Calculator

By S.A. Yakush, Ph.D.

INTRODUCTION

Two of the more useful programs in the Texas Instruments SR-52 programmable calculator's Basic Library (BA1) are BA1-09-1 Ordinary Annuity (1) and BA1-09-2 Ordinary Annuity (2).

The first of these programs uses the interest per payment period (I%) on a loan and three of the following, principal value (PV), payment per period (PMT) or number of payments (N) to derive the third of these values. This is useful in determining the payment required for a loan of PV dollars for N months at I% per month or any of the possible variants.

The second program uses PV, PMT and N to derive I%. This is useful for converting add-on interest to annual percentage rate.

The primary disadvantage of these programs is that they require two program cards. This makes switching back and forth between their functions rather inconvenient.

This article describes a program written for the SR-52 which incorporates all of the above functions plus two others on ONE program card.

Ordinary Annuity
General Instructions.

Step	Procedure	Enter	Press	Display
1	Enter program (A & B)			
2	Initialize		E'	0.00
3	Enter three of the following:			
	Principal Value	PV	A	PV
	PayMenT per period	PMT	B	PMT
	Number of periods	N	C	N
	Interest per period	I%	D	I%/100
4	Obtain the fourth value:			
	Principal Value		A'	PV
	PayMenT per period		B'	PMT
	Number of periods		C'	N
	Interest per period		D'	I%
	To find the Remaining Value and Interest Paid after M payments			
	Enter number of payments	M	E RUN	RV IP

Ordinary Annuity
Program Listing.

```
LOC CD KEY     LOC CD KEY     LOC CD KEY     LOC CD KEY
000 46 LBL     056 43 RCL     112 46 LBL     168 04  4
001 17  B'     057 00  0      113 18  C'     169 54  )
002 43 RCL     058 02  2      114 01  1      170 45  Y^X
003 00  0      059 75  -      115 75  -      171 43 RCL
004 01  1      060 17  B'     116 43 RCL     172 00  0
005 65  X      061 80 IF+     117 00  0      173 05  5
006 43 RCL     062 00  0      118 01  1      174 95  =
007 00  0      063 06  6      119 65  X      175 81 HLT
008 04  4      064 07  7      120 43 RCL     176 75  -
009 55  ÷      065 94 +/-     121 00  0      177 43 RCL
010 53  (      066 22 INV     122 04  4      178 00  0
011 01  1      067 50 STF     123 55  ÷      179 01  1
012 75  -      068 00  0      124 43 RCL     180 85  +
013 53  (      069 75  -      125 00  0      181 43 RCL
014 01  1      070 93  .      126 02  2      182 00  0
015 85  +      071 00  0      127 95  =      183 05  5
016 43 RCL     072 01  1      128 23  LN     184 65  X
017 00  0      073 95  =      129 94 +/-     185 43 RCL
018 04  4      074 80 IF+     130 55  ÷      186 00  0
019 54  )      075 00  0      131 53  (      187 02  2
020 45  Y^X    076 03  3      132 01  1      188 95  =
021 43 RCL     077 09  9      133 85  +      189 81 HLT
022 00  0      078 43 RCL     134 43 RCL     190 46 LBL
023 03  3      079 00  0      135 00  0      191 11  A
024 94 +/-     080 04  4      136 04  4      192 42 STO
025 95  =      081 65  X      137 54  )      193 00  0
026 56 RTN     082 01  1      138 23  LN     194 01  1
027 46 LBL     083 00  0      139 95  =      195 81 HLT
028 19  D'     084 00  0      140 81 HLT     196 46 LBL
029 00  0      085 95  =      141 46 LBL     197 12  B
030 42 STO     086 81 HLT     142 15  E      198 42 STO
031 00  0      087 46 LBL     143 42 STO     199 00  0
032 04  4      088 16  A'     144 00  0      200 02  2
033 01  1      089 43 RCL     145 05  5      201 81 HLT
034 42 STO     090 00  0      146 43 RCL     202 46 LBL
035 00  0      091 02  2      147 00  0      203 13  C
036 00  0      092 55  ÷      148 02  2      204 42 STO
037 50 STF     093 43 RCL     149 55  ÷      205 00  0
038 00  0      094 00  0      150 43 RCL     206 03  3
039 02  2      095 04  4      151 00  0      207 81 HLT
040 22 INV     096 65  X      152 04  4      208 46 LBL
041 49 PRD     097 41 GTO     153 95  =      209 10  E'
042 00  0      098 00  0      154 75  -      210 57 FIX
043 00  0      099 01  1      155 53  (      211 02  2
044 43 RCL     100 00  0      156 43 RCL     212 25 CLR
045 00  0      101 46 LBL     157 75  -      213 47 CMS
046 00  0      102 14  D      158 43 RCL     214 81 HLT
047 60 IFF     103 55  ÷      159 00  0
048 00  0      104 01  1      160 01  1
049 00  0      105 00  0      161 54  )
050 05  5      106 00  0      162 65  X
051 03  3      107 95  =      163 53  (
052 22 INV     108 42 STO     164 01  1
053 44 SUM     109 00  0      165 85  +
054 00  0      110 04  4      166 43 RCL
055 04  4      111 81 HLT     167 00  0
```

```
LABELS
A   Enter PV
B   Enter PMT
C   Enter N
D   Enter I%
E   M -> RV & IP
A'  Find PV
B'  Find PMT
C'  Find N
D'  Find I%
E'  Initialize

REGISTERS
00 delta
01 PV
02 PMT
03 N
04 I%/100
05 M

FLAGS
0  used
```

Ordinary Annuity
Sample Problems.

Step	Procedure	Enter	Press	Display
1	Enter program (A & B)			
2	Initialize		E'	0.00
3	To find payment			
	Enter PV	3500	A	3500.00
	Enter N	18	C	18.00
	Enter I%	1	D	.01
	Find PMT		B'	213.44
	Store PMT		B	213.44
4	To find principal value			
	Enter PMT	213.44	B	213.44
	Enter N	18	C	18.00
	Enter I%	1	D	.01
	Find PV		A'	3500.00
	Store PV		A	3500.00
5	To find number of payments			
	Enter PV	3500	A	3500.00
	Enter PMT	213.44	B	213.44
	Enter I%	1	D	.01
	Find N		C'	18.00
	Store N		C	18.00
6	To find interest per period			
	Enter PV	3500	A	3500.00
	Enter PMT	213.44	B	213.44
	Enter N	18	C	18.00
	Find I%		D'	1.00
	Store I%		D	.01
7	Find remaining value after M payments			
	Enter M	12	E	1237.04
			RUN	298.28

MATHEMATICAL DESCRIPTION

If we let $F = 1 - 1/(1+r)^N$ where $r = I\%/100$ then the appropriate formulas are as follows:

$$PMT = PV \times r/F$$
$$PV = PMT \times F/r$$
$$N = Ln(PMT/(1 - PV \times r))/Ln(1+r).$$

Since r cannot be isolated in any of the above formulas, a search on the interval (0,1) must be done to find r. When the four values PV, PMT, N and I% are known, the remaining value (RV) of the loan after M payments can be found using

$$RV = PMT/r - (PMT/r - PV) \times (1+r)^M$$

and the amount of interest which has been paid (IP) can be found using

$$IP = M \times PMT - (PV - RV).$$

PROGRAM DESCRIPTION

This program allows one to enter any three of the values PV, PMT, N or I% and find the fourth value using the above formulas for the first three and a bisection search method on (0,1) to find r. Once all four values are known and stored in the appropriate registers (see Table 1 or Table 3), M can be entered to find RV and IP. The program assumes (as do the formulas) that all periods are equal in length and that the payments are made on exactly the due date.

Table 1 gives the general instructions for use of the program which is listed in Table 2. Table 3 shows the use of the program on several sample problems.☐

ABOUT THE AUTHOR

Andrew Yakush has an M.A. and a Ph.D. in Mathematics from the University of Southern California and is Assistant Professor of Biomathematics in the Medical School of Loma Linda University in Loma Linda, California. He teaches courses in Biological Control Theory and Modeling of Biological Systems and does research in pharmacokinetics and related areas.

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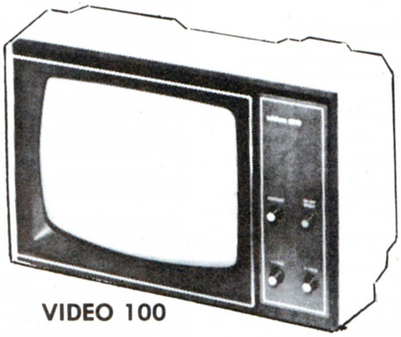

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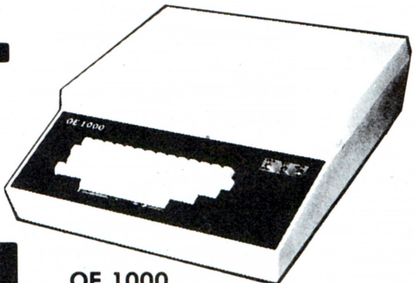

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A Report on the Intel 8085

By Ralph L. Place

Intel's 8085 microprocessor is a "second-generation" version of their widely-used 8080. In the development of the 8085, Intel maintained software compatibility as a primary goal at the expense of hardware compatibility. In fact, some of the hardware disadvantages of the 8080 (in particular the requirement for a multivoltage power supply) helped to motivate the development of the new microprocessor.

A cursory comparison of the pin configurations for the 8080 and 8085 as shown in Figure 1 reveals that they both are 40-pin packages, but very little else is the same. The most prominent changes that are first noticed are the single voltage (+5V) requirement and the multiplexed data-address bus (AD_0-AD_7) for the 8085. The immediate benefit of the single voltage power supply is obvious. These changes also bring about another benefit since the pins that would otherwise have been used are now available for new signal or status information.

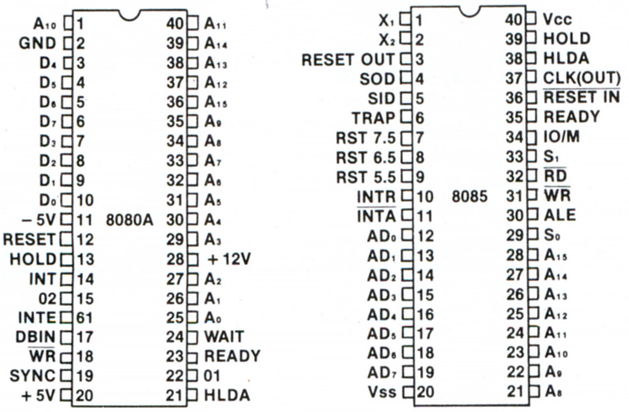
8080A
A_{10} 1
GND 2
D_4 3
D_5 4
D_6 5
D_7 6
D_3 7
D_2 8
D_1 9
D_0 10
−5V 11
RESET 12
HOLD 13
INT 14
02 15
INTE 61
DBIN 17
$\overline{WR}$ 18
SYNC 19
+5V 20
40 A_{11}
39 A_{14}
38 A_{13}
37 A_{12}
36 A_{15}
35 A_9
34 A_8
33 A_7
32 A_6
31 A_5
30 A_4
29 A_3
28 +12V
27 A_2
26 A_1
25 A_0
24 WAIT
23 READY
22 01
21 HLDA
8085
X_1 1
X_2 2
RESET OUT 3
SOD 4
SID 5
TRAP 6
RST 7.5 7
RST 6.5 8
RST 5.5 9
$\overline{INTR}$ 10
$\overline{INTA}$ 11
AD_0 12
AD_1 13
AD_2 14
AD_3 15
AD_4 16
AD_5 17
AD_6 18
AD_7 19
Vss 20
40 Vcc
39 HOLD
38 HLDA
37 CLK(OUT)
36 $\overline{RESET\ IN}$
35 READY
34 IO/M
33 S_1
32 $\overline{RD}$
31 $\overline{WR}$
30 ALE
29 S_0
28 A_{15}
27 A_{14}
26 A_{13}
25 A_{12}
24 A_{11}
23 A_{10}
22 A_9
21 A_8

Figure 1.

Another important improvement is the "on-board" clock in the 8085. The 8080 requires an external two-phase 2MHz clock to supply the timing pulses ϕ_1 and ϕ_2. This requirement is eliminated in the 8085. The only external component required is a crystal to control the 8085 timing oscillator. The 8080 has a typical cycle time of 500 nsec, whereas the 8085 runs about 36% quicker at 320 nsec. The difference in timing circuit requirements is shown in Figure 2.

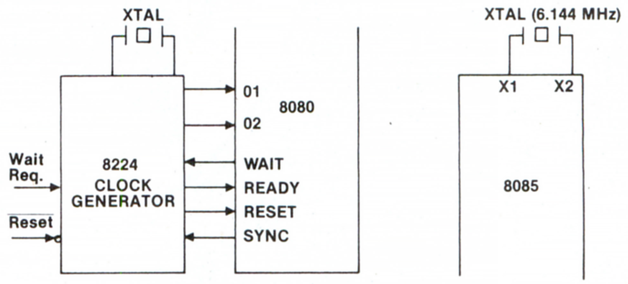
XTAL
8224
CLOCK
GENERATOR
Wait
Req.
$\overline{Reset}$
01
02
8080
WAIT
READY
RESET
SYNC
XTAL (6.144 MHz)
X1
X2
8085

Figure 2.

It would seem that this decrease in cycle time for the 8085 would mean that memory access time must be considerably quicker than the maximum allowed for the 8080. However, this is not the case. Referring to Figure 3, we see the timing pulses involved in determining the necessary memory access time. This figure also shows the timing involved with the address-data bus multiplexing. During the first clock cycle (T1) of the first machine cycle (which consists of 4-6 clock cycles depending on the operation), the address of the memory location to be accessed is put on the address-data bus.

As T2 is entered, the lower 8 bits of the address are removed from the address-data bus, and this part of the bus is put into a high-impedance condition to clear these lines for use as an input 8-bit data bus. At this time during T2, the $\overline{RD}$ line goes low, signalling the accessed memory location to dump its 8 bits of data onto the now available data bus. The data appears on the bus, becoming valid after a time which depends on the access time of the memory. The data must be valid early in the third clock cycle, T3. It is during T3 that the CPU reads the data and raises $\overline{RD}$, thus disabling the memory and sending the data bus into its high-Z condition (signified by the dashed line).

The data can appear on the multiplexed data bus at any time after $\overline{RD}$ goes low but must be valid during the early part of T3. If one has a particularly slow memory, the 8085 can be put into a WAIT state by driving READY low during T2. The maximum time between when the memory address becomes valid and when data must be valid on the bus in order to be read during T3 is given by Intel[1] as,

$$t_{AD} = (2.5 + N)\,320 - 225 \text{ nsec}$$

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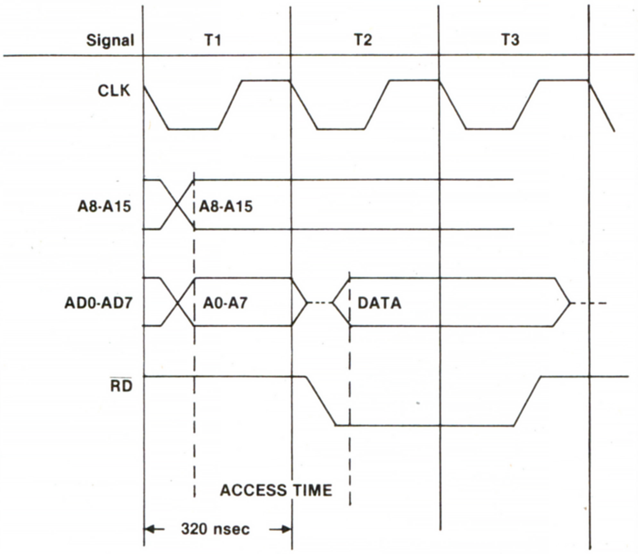


Figure 3.

where N is the number of wait states. Thus, if we want to operate with no wait states, the access time must be less than 575 nsec. This means that most memories that have become available for use with the 8080 (typically having access times of 450 nsec or less) can be used with the 8085 without the need for the insertion of WAIT states. Thus, although the 8085 cycle time is about 36% faster than that of the 8080, peripherals do not have to have correspondingly faster access times.

The timing shown as shown in Figure 3 is the same for OP-CODE FETCH, I/O READ, and MEMORY READ operations.

The improvement in cycle time is reflected in faster execution times for the 8085 *vs* the 8080. Programs written for the 8080 will run without modification on the 8085 due to the upward-compatibility designed into the 8085. This means that 8080 programs will always run on the 8085, but 8085 programs may not run on the 8080. The latter is true if the 8085 program uses the new interrupt or serial I/O features of the 8085, which will be discussed later.

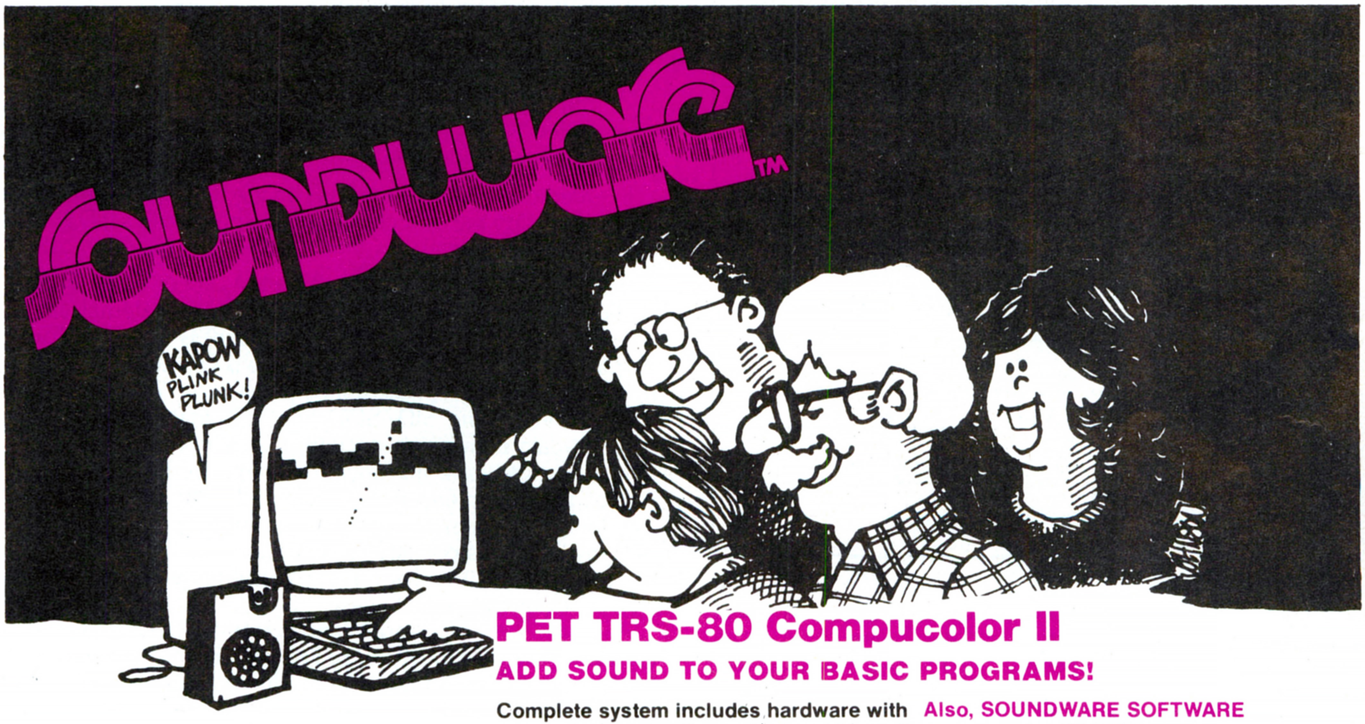
Although an 8080 program will run on an 8085, it might not do what is expected if (for example) the instruction cycle time is used in delay subroutines. Instruction cycle times for the 8085 are not in all cases simply 36% quicker than those for the 8080. The reason for this is that some instructions are executed in a different number of clock cycles on the 8085 than on the 8080. Several such instructions are shown in Table 1 together with their 8085 and 8080 cycle

Table 1.

Instruction	Cycles on 8085	Cycles on 8080	Time on 8085(μsec)	Time on 8080(μsec)	% Improvement
CALL	18	17	5.76	8.5	32%
MOV r_1,r_2	4	5	1.28	2.5	49%
All Conditional Jumps	7/10*	10	2.24/3.2	5.0	55%/36%
XTHL	16	18	5.12	9.0	43%

Instruction time improvements of the 8085 vs 8080. The times are calculated on the basis of a 500 nsec time for the 8080 and a 320 nsec time for the 8085. These illustrate only a few of the instructions, for complete details, refer to Ref. 1,2.

*The lower number of cycles occurs when the condition is not met. The greater number occurs when the condition is met and a new address must be placed in the program counter.



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times. These are not all the instructions having cycle differences. One should consult the appropriate manual[1,2] for further details.

The changes discussed thus far are, except where timing considerations become important, transparent to the programmer. The new serial I/O and interrupt pins on the 8085 are available to the programmer via the new SIM (Set Interrupt Mask) and RIM (Read Interrupt Mask) commands and result in extending the versatility of the 8085 considerably over the 8080.

The interrupt commands of the 8080 are retained in the 8085. This means that to enable/disable interrupts, the EI/DI instruction must be executed. The 8080 has but one interrupt line, namely, pin 14, INT. The corresponding pin on the 8085 is pin 10, INTR. The 8080 and 8085 both respond identically to signals present on this line.

Upon receiving an interrupt request on INT/INTR, the 8080/8085 looks for an 8-bit instruction supplied by the interrupt generating peripheral device. This typically is a RST (Restart) command which causes program execution to jump to one of the locations 0, 8, 16, 24, 32, 40, 48, or 56 in memory. Further instructions can be stored at these locations for interrupt servicing. Since the contents of the program counter is pushed onto the stack by the RST instruction, continuation of the interrupted program is possible by appropriately including a RET (Return) as the last statement in the interrupt-servicing routine.

The 8085 has four additional interrupt pins (TRAP, RST 7.5, RST 6.5, and RST 5.5). Interrupt requests on these lines result in automatic restart of program execution at predetermined (i.e., not supplied by the interrupting device) addresses. In addition, all the interrupts are prioritized and (except for TRAP and INTR) are maskable. Some of the features of the 8085 interrupts are outlined in Table 2.

Interrupt	Features
TRAP	1. Cannot be disabled. 2. Cannot be masked. 3. Restart Address 24H. 4. Edge and level sensitive. TRAP line must remain high to be acknowledged. It must then go low and high again to be reacknowledged.
RST 7.5	1. Maskable using the SIM instruction. 2. Restart Address 3CH. 3. Rising edge sensitive. A short pulse will trigger this interrupt. Input does not have to stay high.
RST 6.5	1. Maskable using the SIM instruction. 2. Restart Address 34H. 3. Level sensitive. Input must stay high for interrupt to be acknowledged.
RST 5.5	1. Maskable using the SIM instruction 2. Restart Address 2CH. 3. Level sensitive. Input must stay high for interrupt to be acknowledged.
INTR	1. Non-maskable 2. Restart Address supplied by interrupting device. 3. Level sensitive. Input must stay high for interrupt to be acknowledged. 4. Identical to the 8080 INT.

Interrupt input lines on the 8085. The interrupts are listed in order of priority, i.e., TRAP has highest priority, INTR the lowest.

Table 2.

In addition to the new interrupt pins, the 8085 has SID/SOD pins. These are used for Serial Input Data and Serial Output Data which, under appropriate software control, can be used as a serial I/O port connected to a peripheral device.

The new interrupt and serial I/O features are accessed using the SIM (Set Interrupt Mask) and RIM (Read Interrupt Mask) commands. The SIM sets the interrupt masks and sets the SOD pin to a logical high or low according to the 8-bit code in the accumulator. The RIM command reads the interrupt mask status flags and the state of the SID pin, inputting the 8-bit result into the accumulator. The meaning of the 8 bits of information for the RIM and SIM commands are tabulated in Table 3.

Data Bit	RIM (20H)	SIM (30H)
D0	=1, RST 5.5 Masked =0, RST 5.5 Not Masked	=1 RST 5.5 Masked (Disabled) =0 RST 5.5 Not Masked
D1	=1, RST 6.5 Masked =0, RST 6.5 Not Masked	=1 RST 6.5 Masked (Disabled) =0 RST 6.5 Not Masked
D2	=1, RST 7.5 Masked =0, RST 7.5 Not Masked	=1 RST 7.5 Masked (Disabled) =0 RST 7.5 Not Masked
D3	=1, Interrupts Enabled =0, Interrupts Disabled	=1 Mask Setting Enabled =0 Mask Setting Disabled
D4	=1, RST 5.5 pending =0, No RST 5.5 pending	=1 resets the RST 7.5 (edge trigger interrupt) internal flip flop
D5	=1, RST 6.5 pending =0, No RST 6.5 pending	Not used
D6	=1, RST 7.5 pending =0, No RST 7.5 pending	=1 Enables SOD line =0 SOD line disabled
D7	Serial input data bit	Serial output data bit

Meaning of the 8-bits of data transmitted via the RIM and SIM instructions.

Table 3.

Even though the SIM instruction is not set to mask (i.e., does not disable) the RST 5.5, RST 6.5, RST 7.5 interrupts, the EI (Enable Interrupt) instruction must be extended in order to enable the interrupts (with the exception of TRAP). The new interrupts on the 8085 give it a total of 12 interrupt levels (the INTR has eight RST addresses available).

The Serial Input and Serial Output data lines are very interesting because they allow the microprocessor to be its own serial I/O port. This is in contrast with the 8080 which can process only parallel data via the IN and OUT commands. The IN/OUT commands are, of course, still available on the 8085, but the peripheral serial-to-parallel parallel-to-serial converters used in a standard SIO port are not necessary when using the SID/SOD lines. In order to use the SID line to input serial data one can simply either

1. continuously poll the SID line, using RIM, rotating the accumulator left into carry to detect changes in logic level
2. put the RIM command in an interrupt routine which is called when the peripheral device generates an interrupt, signifying data coming in.

In order to output data, the level on the SOD line is changed simply by using the SIM command (being sure to set D3, D6 and D7 appropriately).

The clocking of data in or out via the SID or SOD lines is controlled entirely by software. There is no external clock whereby the data transmission rate (baud) is set. Therefore, to transmit data at a specified baud, the I/O software routines must have the appropriate built-in delay.

Even though the SID/SOD lines eliminate the need for external data conversion circuitry that is normally required, one still has to have the driving circuitry for the peripheral-microcomputer interface. For example, if the peripheral is a standard TTY, then the 20-mA current loop circuitry must be provided. This circuitry is then driven by the SOD signal or, conversely, provides for the current-to-voltage conversion for input to the SID line.

All-in-all, these hardware changes result in the 8085 as being easier than the 8080 to power and more versatile in interrupt capabilities, in addition to eliminating external clock circuitry. Serial I/O is also simplified. Coupled with a quicker cycle time, these features make the 8085 a powerful CPU for a microcomputer system.☐

REFERNCES

[1] *MCS-85™ Users Manual,* Intel Corporation, 1977.
[2] *MCS-80™ Users Manual,* Intel Corporation, 1975.

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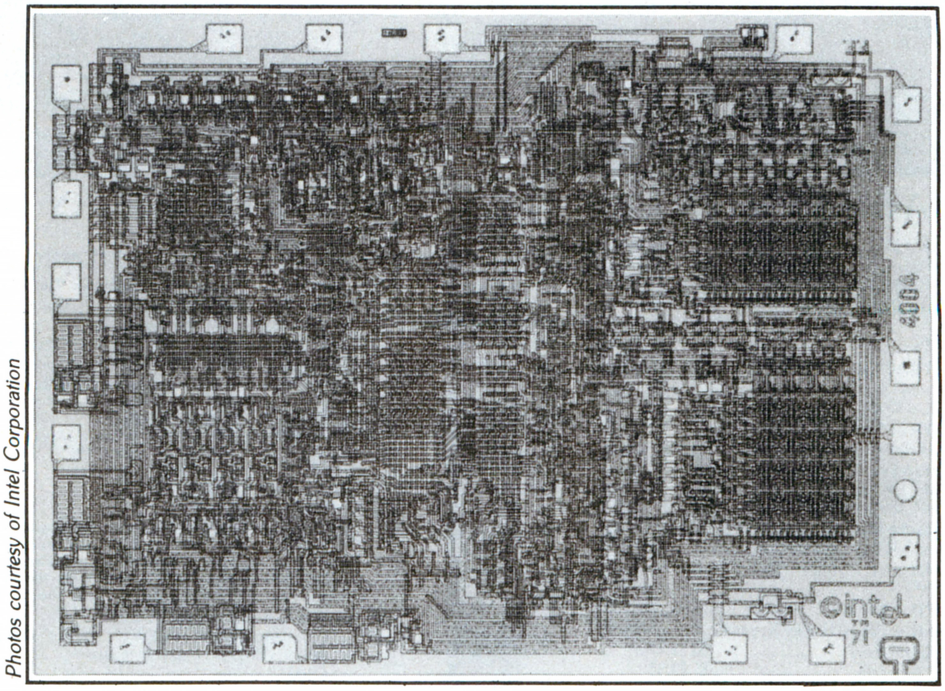

Photos courtesy of Intel Corporation

PHOTO 3

INTRODUCTION TO MICROPROCESSORS

Traditionally a computer system consists of three functional stages (units).

1. Central Processing Unit (CPU)
   - (a) Registers (temporary storage)
   - (b) Arithmetic Logic Unit (ALU)
   - (c) Control Unit (C.U.)
2. Memory
   - (a) Operational
   - (b) Program/Data
   - (c) External
3. Input/Output Facility (I/O Ports)
   - (a) Information Input
   - (b) Processed Information Out

To complete our computer system we naturally would have to include the peripherals such as input and output equipments. At this point in time, we are not interested in a complete computer, but only in one of its functional units, the Central Processing Unit (CPU).

CENTRAL PROCESSING UNIT

The CPU is often referred to as either the ''heart'' or the ''brains'' of a system since it is here that the calculations and logic operations are performed, as well as system control being generated and exercised. In short, the unit is a processor of data bits and time intervals (control and timing signals).

Concepts

Instead of pinpointing by a definitive statement, we shall attempt to develop a conceptional viewpoint of the Microprocessor Unit (MPU).

Taking another look at our conventional Central Processor Unit, we find:

(A) Typical Arrangement (Architecture)
  1. Registers
     - (a) Accumulator
     - (b) Program Counter
     - (c) Instruction Register & Decoder
     - (d) Data Register
     - (e) Address Register & Decoder
     - (f) Index Registers
     - (g) Memory Register
     - (h) Status Register

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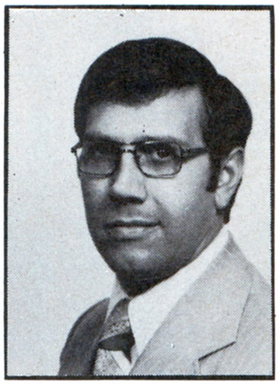

(TRS-80 PET APPLE II.)

Your microcomputer has the potential of paying you back a fantastic return on your investment by helping you make exceptional income property buys. This is the opinion of Virg Gering, a computer systems analyst and experienced real estate investor who developed the software to analyze income property.

"You can easily ***find investments which yield 100% increase in equity*** in the first year," claims Gering. "You can look at more property — and with a depth of analysis which is almost impossible by hand calculations."

"The income property analysis program was created by sheer necessity," Gering asserts. "As a beginning investor I was overwhelmed by the number of variables which must be taken into consideration when purchasing property.

I found myself limited to the number of properties which I could analyze because of the sheer volume of "pencil pushing" that was required. I then got the idea to feed this data into a computer and let it do the calculations for me. "This was a break-through!," exclaims Gering. "I was able to expand my search and analyze many more properties than would otherwise be possible by manual calculations."

"This is a ***dynamic tool for professional real estate people to demonstrate how income property investments really work***", says Gering. "There is a dire need for a vehicle of communication to explain in realistic and simplistic terms what cash flow, equity build-up and tax advantage are all about." The client can see how these categories change as you analyze various properties.

Gering points out how his program ***allows the user to restructure the offer*** again and again. "Each time a new offer is constructed, the computer will display a new analysis. By experimentation with the purchase price, down payment, trade equity, subordinate mortgage, interest rates, etc., the buyer has a ***powerful tool for optimizing the offer*** in his favor.

The user can investigate ***potential for remodeling and upgrading!*** He can experiment with various degrees of remodeling and projected rent schedules and instantly see the impact upon the cash flow, equity build-up, tax advantage, return on investment, etc.

You may also investigate the potential for ***conversion of a central heating system to individual heat!*** This is what Gering refers to as ***"taming the alligator."*** "With today's high energy costs it is becoming prohibitive to pay for someone elses heat. The analysis will show how profitable the conversion will be.

The modules for remodeling and heat conversion will help you find property which has been neglected but has a potential for dramatic improvement.

There are several features which cater to the novice investor. One example is the ability of the program to ***estimate the cost of monthly maintenance*** based upon age, number of units, average rent per unit, average square feet per unit and the type of construction.

You can also ***avoid the painful experience of an unexpected negative cash flow!*** "After a couple trips through this wringer you can certainly appreciate this feature."

The user may also ***view the payoff period of all mortgages.*** This includes any subordinate mortgages as well as new loans as a result of planned remodeling and/or heating system conversions. Gering also gives credence to those veterans who use "horseback estimates" by including the opportunity to see ***various Rule-of-thumb appraisals.*** Here are many of the favorite formulas which have been used over the years.

"One of the most satisfying aspects of this program is that it illustrates what '***forced inflation***' is all about," concludes Gering. "This is the single most important element for the investor who has the motivation to achieve a fortune in equity in a short period of time.

Virg Gering is a Computer Systems Analyst for a state university. He is also a Computer Systems Operations Officer for the Wash. Air National Guard. He holds an AS degree in Data Processing and a BA in Business. He has over ten years experience in systems and programming. He is also an experienced investor in income properties. In five years, in his spare time, he has progressed from a net worth of $6,000 to over $200,000. He points out that this achievement is certainly not spectacular — many people have accumulated over a million dollars in equity in the same period of time.

This software package is distributed by Aukland Associates. It sells for $62. This includes a documentation manual which explains the analysis and gives special insight and tips on investment strategy. It is available in cassette for the TRS-80, PET and APPLE II (BASIC II, 16K). If you are interested in this software but have a different computer, fill out the coupon (send no money) and you will be notified when available.

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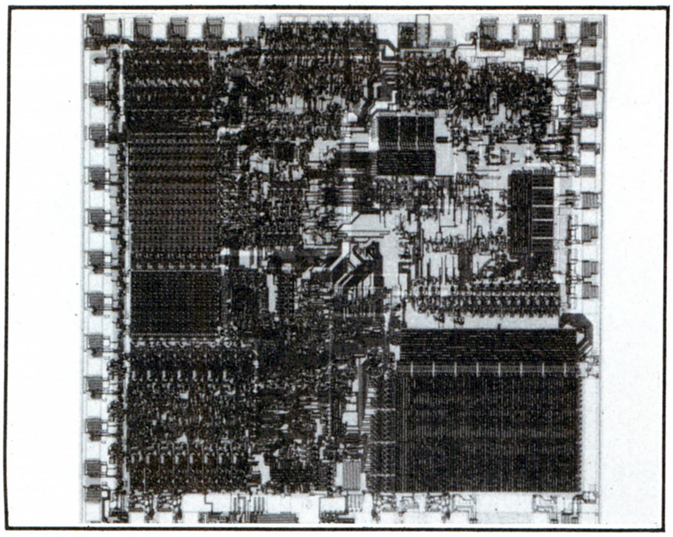

PHOTO 4

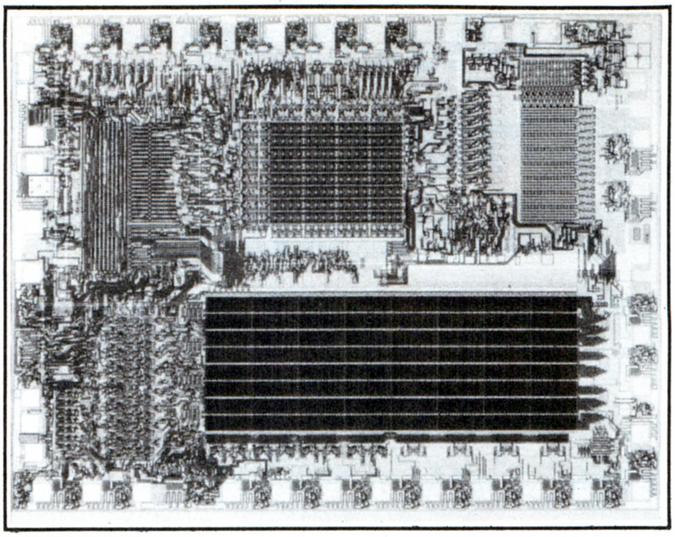

PHOTO 5

2. Arithmetic Logic Unit (ALU)
   - (a) Adder
   - (b) Carry Circuits
   - (c) Logic Circuitry
3. Processor Control
   - (a) Timer Circuits, clock generator
   - (b) System Control Circuitry

The basic architecture of the processing unit of most computers is generally the same in the sense it can be dissected into registers, arithmetic logic unit, and processor control. The size (computing power) of the processor unit is generally set by design which in turn is influenced by data processing, dedicated control, and/or scientific requirements.

(B) Physical

A functional block diagram of the older systems of discrete component technology often mislead a person into thinking that all the printed circuit boards that comprised the CPU were centralized in one section of the rack. With some equipment this was not so, because certain CPU boards were scattered throughout the different card bays of the rack. In some of the mainframe computers these racks were swing-aways so the technician could work from either the card insertion side or the wiring side.

The number of discrete components utilized by the CPU in "pre-IC" days totaled up to quite a few, and encompassed a lot of real estate (area). This real estate area was cut considerably with the advent of LSI integrated circuits. A certain 40-pin IC microprocessor measures 1.94 inches x .5 inches, giving us .970 square inches of area. However, the *processor chip* only takes up .035 square inches of area of the IC package. Compare this to some of the previous mainframe processors areas of 500 to 2,000 square inches.

Today it is not uncommon to find a single board computer (of sorts) taking up an area of 99 square inches. Our microprocessor serves the same function as the Central Processor Unit of the large computers. Some view the CPU as being reduced in physical size by LSI technology and referred to as a microprocessor unit (MPU). The terms microprocessor and microcomputer are quite often used interchangeably. A processor is but one component of the computer, whereas the computer as a whole may be considered a processor. In industrial applications the microprocessor is also referred to as the CPU.

Types

The larger computers generally utilize word lengths of 32 to 64 bits. In the microcomputer category we find 1-, 4-, 8-, 12- and 16-bit processors. For data processing applications, the 1- and 4-bit processors generally do not fulfill the requirements. For some dedicated control purposes they are well suited.

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Table 22.
Applications of 1- & 4-Bit Microprocessors

- Appliance Control
- Automotive Systems
- Cash Registers
- Calculators
- Industrial Controls
- Protective Systems
- Telephone Systems
- Traffic Systems
- Typewriters
- Television Tuners

Photo 3 shows a photomicrograph of the Intel 4004 microprocessor (4-bit) developed for calculator use in the early seventies. With the advent of the Intel 8008 processor, microcomputing became a realization and other processors soon made their appearance. Although not inclusive, Table 23 shows some of the processor units in use today.

Table 23.

	1-BIT	4-BIT	8-BIT	12-BIT	16-BIT
Fairchild			F8/3850		9440
Intel		4004 4040	8008 8080A 8085		8086
Intersil				IM6100	
MOS			6502		
Motorola	MC145008		MC6800		MC68000
National Semiconductor		IMP-4	8080A IMP8 SC/MP	PACE	IMP-16
RCA			COSMAC/ CDP1802		
Rockwell		RPS4	PDS8		
Signetics			2650		
Texas Instruments					9900
Zilog			Z-80		Z8000

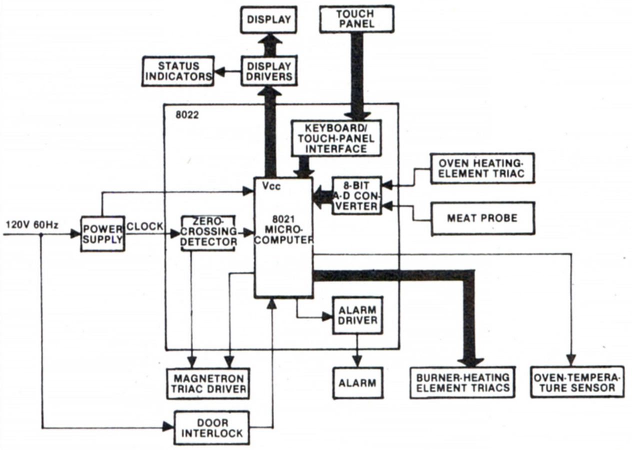
Differences

Table 23 shows various processors categorized by data word bit length. Several 8-bit processors are listed, but where do they differ? These differences are generally in the following:

1. Address Modes
2. Address Bits
3. Interrupts
4. Instruction Set
5. Execution Speed
6. Internal Bus Structure

In addition, there is the number of chips necessary to comprise a complete CPU. For example, the Intel 8080 CPU is composed of the 8080 microprocessor, the 8224 clock, and the 8228 controller (3 chips). Whereas the Intel 8085 incorporates all three in a single chip.

Photo 4 is a photomicrograph of the Intel 8086, 16-bit processor. A typical application for this device could involve a process which continually carries out complex mathematical calculations on income sensor data and makes decisions based on the outcome.



The 8022 is used here as a controller for a combination microwave and conventional oven. The 8022 requires no external circuitry to interface thermistors connected to its analog inputs, read touch panel inputs, detect zero-crossing of AC power for firing triacs and gating clocks and timers, direct-driving an alarm, and storing cooking time instructions.

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Figure 122.

Figure 122 illustrates a functional block diagram of a microwave/conventional oven controller (Intel 8022). This single-chip microcomputer combines an 8-bit analog-to-digital converter and an 8-bit microcomputer on the same chip. Photo 5 is a photomicrograph of the 8022 chip.

Instruction

In a microprogrammed processor, an instruction (FROM MAIN MEMORY-RAM) causes the Program Memory (ROM) to generate a bit pattern (microinstruction) which in turn initiates the binary signals (control) that activates the circuits for execution of the instruction. These bit patterns are

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stored in the memory that is generally referred to as the Control, Program or Microprogram memory. The type of memory utilized to store these bit patterns is either the ROM or the PROM (read only memories). Once this memory has been programmed it cannot be altered. It is set.

This group of bit patterns (instructions) that informs the processor what operation to perform is called the instruction set and is produced by the microprocessor manufacturer. A hypothetical example of an instruction to subtract would be written in *mnemonic* form followed by an operational code that is numerical, stated in the hexadecimal equivalent of the binary bit pattern in ROM.

MNEMONIC	OP CODE	BIT PATTERN
SUB	61	0110 0001

The above is merely an instructional example and in order to be purposeful, data and addresses have to be included in the overall instruction from Main Memory (RAM).

Wares

In microcomputer terminology there are three terms that encompass the microcomputer:

- I. Hardware
  - (a) Relates to the circuitry and equipment.
- II. Firmware
  - (a) Relates to the operational program set in the ROM memory.
- III. Software
  - (a) Relates to the source program written by the programmer.

Communication

The microcomputer in operation is a rather busy device and consequently is in need of traffic orientation. In the conventional microcomputer this is taken care of by the three bus (paths) structure.

- I. Address Bus
  - (a) As the term implies: to where and from where.
- II. Data Bus
  - (a) Unprocessed and processed data information. (Bi-directional, generally accomplished by 3-state logic).
- III. Control Bus
  - (a) Control signals to implement synchronization.

Summation

The intent of this part of our tutorial in the Mini-Series has been to serve as an introduction to the LSI microprocessor, the heart and/or brains of the microcomputer. As mentioned previously, in the building of a house the foundation first, then the enhancements. We now begin with the enhancements.

MEMORIES

From the initial conception of control of work functions and data processing, there have been many concepts in the storage of information. From the mechanical viewpoint: templates, cams, measuring devices, punched cards, tape, etc. were utilized in the various requirements of industry and commerce.

Possibly the first practical retention of data information might have originated from the early railroad ticket, a preformed (programmed) format that when punched retained information such as origination, destination and class of fare. Punched cards and paper tape have been used extensively for many years, even before the advent of the early computers.

As data processing requirements grew, computing technology developed rapidly. However, the ultimate need for working and mass storage still remained. These requirements were capacity as well as access time; the ability to enter and retrieve information. In addition, permanence was also a requirement. From this viewpoint, it was only natural at this time that magnetic principles of digital recording with proper techniques were considered.

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Of the various magnetic types of memory, the magnetic core and magnetic tape became prominent types of memory. Physically, both are composed of a powdered magnetic substance called ferrite. The core can be magnetized in one direction or the other, representing a binary one and binary zero respectively. The tape can be magnetized as a binary one and the absence of a magnetized spot can represent a binary zero. Both are suitable for a two-state representation (digital).

A constant development of solid state technology brought about miniaturization and micronization of computer components, consequently packing (density), access time and capacity of memory units has had to follow. Now solid state memories have been developed in both bipolar and MOS form (ROM and RAM), as well as charged coupled devices (CCD). Needless to say, the newer magnetics are in there as contenders in the form of magnetic disk memories and magnetic bubble memories.

Types of Memory (Prominent)

1. Magnetic Tape
2. Magnetic Disk
3. Magnetic Drum
4. Magnetic Bubbles
5. MOS Shift Register
6. Charged Coupled Devices
7. Dynamic RAM
8. Bipolar RAM
9. ROM/PROM/EPROM

TERMS

Access Time

Time required to either write a word into memory or read a word from it.

Cycle Time

Time required to obtain information from memory and then write it back into memory.

ROM

Read Only Memory, once programmed it cannot be changed.

PROM

Field programmable read only memory.

EPROM

A ROM that can be erased by ultraviolet light and reprogrammed.

Destructive Read Out: (DRO)

Information in memory is destroyed when it is read out of memory.

Non-Destructive Read Out: (NDRO)

When information is read out it is automatically written back into its location in memory.

Main Memory

Stores instructions and data of the source program.

Static Memory

Storage where the information does not change position, examples are flip-flops and magnetic cores.

Dynamic Memory

Storage where information is changing position continuously. Magnetic disks and circulating registers are examples.

Refresh

To re-charge or re-energize.

Volatile Memory

Storage devices that upon loss of electrical power lose all stored information.

Table 24 lists the various types of memory according to their capacity and cycle time.

As we can readily ascertain from the table, there is a trade off as far as capacity and cycle time are concerned. The ultimate in memories would be capacity-infinite, cycle time-infinitesimal and permanence forever.

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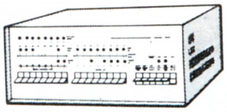

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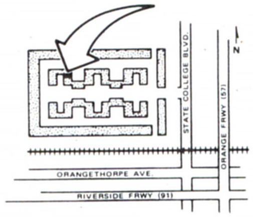

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Table 24.

Memory	Capacity	Time
Magnetic Tape	20-100 million bits per reel	Slow
Magnetic Disk	10-15 million bits per disk	Better than tape, slower than drum
Magnetic Drum	1-250 million bits per drum	Faster of the disk, tape, drum category. Typically 4-10 milliseconds
CCD & Magnetic Bubble	50K-250K bits per chip	Slowest of the newer memory technologies, but faster than the tape, disk and drum
Shift Registers	Approximately 1,000 bit per chip	Somewhat dependent on repetition rate & clock frequency
Dynamic RAM	Up to 32K bits per chip	Faster MOS technology
Bipolar RAM	Up to 16K	Fastest of all at the present

The subject matters of this tutorial will be brought forth again in greater detail in succeeding articles relating to the microcomputer. Next month our subjects will include converters, encoders and decoders. The understanding of these subjects then makes it possible for us to put it all together in the form of a microcomputer.☐

SUMMARY/QUIZ TUTORIAL #6

1. Which of the following belongs to the ALU: (A) memory register, (B) clock generator, (C) carry circuit, (D) program counter, (E) instruction decoder.
2. The data word length of an 8-bit processor would be (A) 1 bit, (B) 16 bits, (C) 8 bits, (D) 4 bits, (E) 32 bits.
3. Which of the following processors are best suited for calculator use: (A) 4004/4040, (B) 8008, (C) 6502, (D) 9440, (E) 8080A.
4. The Intel 8085 CPU is: (A) a 16-bit device, (B) a tri-chip device, (C) 4-bit device, (D) single chip device, (E) dual chip device.
5. Microinstructions for a microprogrammed processor are generally stored: (A) in the main memory, (B) in a RAM device, (C) on cassette tape, (D) in program memory (ROM), (E) in temporary storage.
6. The group of bit patterns that tell the processor what operation to perform is called: (A) a word, (B) the instruction set, (C) a byte, (D) the address, (E) the control unit.
7. Firmware relates to: (A) equipment, (B) circuitry, (C) the source program, (D) control unit, (E) the operational program in ROM.
8. Which of the following is not a magnetic type memory: (A) dynamic RAM, (B) drum, (C) tape, (D) disk, (E) bubble.
9. The time required to either write a word into memory or read out of it is referred to as: (A) cycle time, (B) refresh, (C) access time, (D) execute time, (E) control time.
10. With respect to the various memories, the fastest cycle time is representative of: (A) magnetic drum memory, (B) magnetic bubble memory, (C) dynamic RAM, (D) CCD memory, (E) bipolar RAM.
11. Please rate the sixth unit of the NTS/INTERFACE AGE Mini Series. (A) Excellent; (B) Good; (C) Average; (D) Poor.

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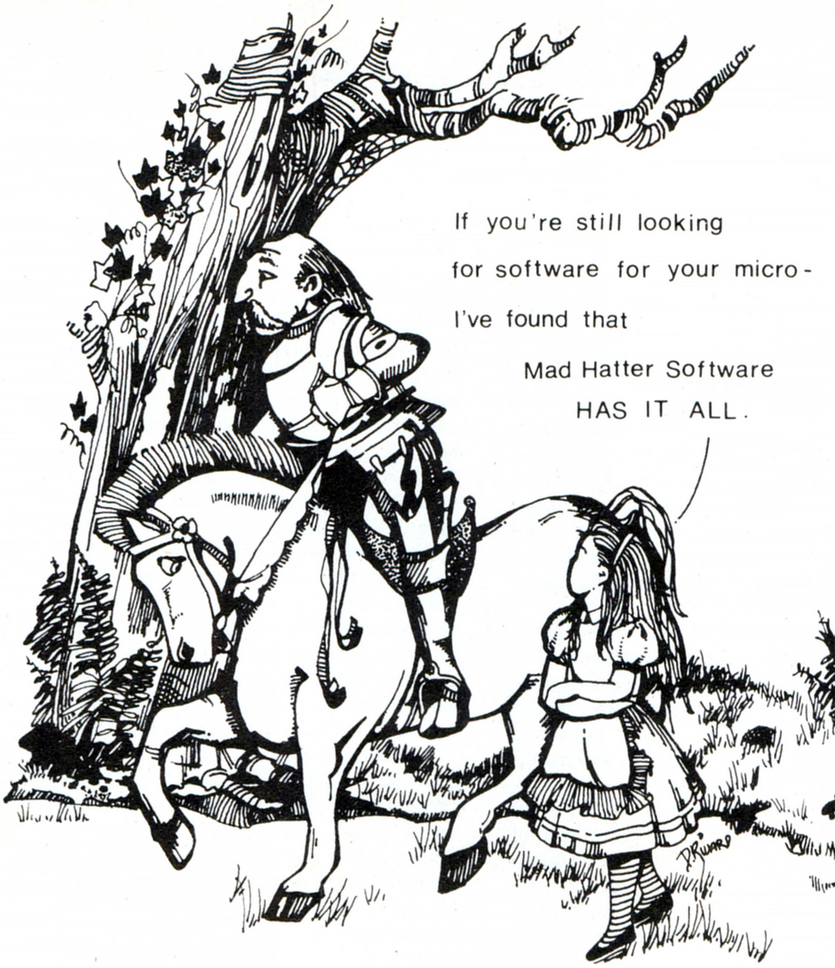

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BOOK REVIEWS

THE INCREDIBLE SECRET MONEY MACHINE

By Don Lancaster
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159 pages, $6.95

Review by Jim Schreier

Once on a visit to an historic Mississippi River town, I happened to tour the home of one Mr. Browning. The small, reconstructed rooms, highlighted by a fireplace, seemed very limiting. Yet Mr. Browning had room to pop popcorn, raise children, milk the cows and construct some first class firearms. If this concept worked in 1842, then why not today?

Of course, the local zoning laws keep us from making firearms in today's kitchens. Or do they? That is one problem Don Lancaster, the Julia Child of electronic cookbooks, examines in his *Secret Money Machine.*

With tongue in cheek and nickel in pocket, Lancaster re-evaluates the credos of large corporations, big business, lawyers, the feds, local government, wives, libraries and caves. "Go into business for yourself," seems to be Mr. Lancaster's thesis, "and live longer!" If you have any questions about such an adventure, Lancaster offers all kinds of details, tips and encouragement.

Lancaster is at his best describing how not to advertise, what not to collect from the tails of Eagles and what the Heath Company can teach you for less than 5¢, plus more.

Lancaster's style is wise and witty, full of fun and optimism. After all, if you successfully follow his advice you'll have not one but two businesses going.

If you are now working for any large, impersonal business of government, it is suggested that you read *Secret Money Machine* at your own risk. In less than an hour, any all-business, red-blooded American will never be the same again.☐

THE SECRET GUIDE TO COMPUTERS, Part I: Basic

9th Edition, 1978

By Russ Walter. 58 pages, $2.75
Published by Russ Walter

Review by Jack Kirschenbaum

The Secret Guide to Computers, Part I is the first book in a series of six guidebooks that claim to "cover. . .all the facets of computers simply but thoroughly." In the preface and on the back cover blurb, the author further claims that the book is "Foolproof. Each edition has been carefully tested and revised. . .No math background required. . . It's fun. . .Simple to read. Particularly popular among kids and adults who want straightforward talk."

As a college instructor I am often asked to recommend a simple book on computers and programming, so I read this book very carefully. I was impressed by the book's content coverage, accuracy and teaching style.

The book meets all the author's claims. How did Russ Walter do it? First, the sequence of topics covered is quite conventional. He covers the fundamentals of the basic commands common to most BASICs, including CDC, Altair, Radio Shack and Hewlett Package; e.g., how to use a keyboard or terminal, running simple programs, editing, how to use variables, printing, input, if. . . then, go sub, subscripting, functions, etc.

Second, his examples are very simple, easy to understand and cute (sometimes too cute). How can a novice get upset while learning to write programs to print love notes or guess favorite colors? Despite the simplicity of the examples, the author does teach the fundamentals of programming and quite a bit more including Flow Charting, Top Down Programming and Debugging tricks.

Third, the author constantly encourages the novice to experiment with each of the commands. The best teacher, he implies, is the computer and his book helps the beginner appreciate that fact.

Fourth, he has anticipated many of the problems that frustrate the beginner and by careful instruction, repetition and reminders minimizes them. His sense of humor, which ranges from "corny" to "zany," has the effect of making the book fun, so any frustration that occurs is bearable.

There is no doubt that this is the ninth revision of a book that has gone through careful debugging and constant improvements. Russ Walter has been perfecting this guide for several years and has taught programming courses at Dartmouth (where BASIC was born). His enthusiasm for computers and his teaching experience is reflected in the book.

The limitations of the book are in part an outcome of one of its goals—to be brief and generalized. Apple, PET, TRS-80 and S-100 users will not find instructions on how to use the special features of their hardware or extensions to the BASIC such as graphics. The book is not a substitute or replacement for the manuals that accompany a computer. The author recognizes these limitations and urges the user to study the manuals that come with their computer to learn how to take advantage of special features.

The book also lacks additional problems for the reader to practice and is short on the many details that make BASIC an easy and powerful language. Most of these limitations are nicely made up in a companion guide called "Hassles in BASIC" and other books in the series.

All things considered, the *Secret Guide* at $2.75 has got to be one of the best buys for a beginner in BASIC. There are no fancy pictures or diagrams, no photographs or color, just vivid, effective use of the English language, with clear examples, charts and program listings.☐

THE BASIC HANDBOOK

An Encyclopedia of the BASIC Computer Language

By David A. Lien. Compusoft Publishers, Inc. 360 pages, $14.95

Review by Patrick McMullen

Have you ever found an interesting BASIC program, entered it into your computer, hit run, and watched all kinds of error messages appear because it was written in another BASIC? The problem is often compounded because you do not have the manual for the other BASIC. A solution to this frustrating dilemma is *The BASIC Handbook.* This paperback explains the commands and functions of 50 popular BASIC dialects.

After a lighthearted explanation of computers and interpreters, the author examines more than 250 BASIC key words and characters. Each word is treated individually. It is categorized as a command, statement, function or operator. If it is part of the proposed ANSI Standard BASIC, this is noted. The word is also concisely described and attributed to the appropriate versions of BASIC.

There is a test program and a sample run to demonstrate and test the operation of each word on your computer. An invaluable feature is the section under each word entitled "if your computer doesn't have it," which describes alternate ways to accomplish the same function. Variations in usage and cross references to other words are included.

There are, however, several glaring omissions to the list of BASIC terms, including "bye", "exit" (with at least two different usages), "eqv" (logical equivalence), "imp" (logical implication) and "not" (one's complement). These commands are found in DEC, Microsoft, North Star and Xitan Disk BASIC.

File handling commands are intentionally ignored. For anyone planning to use this book as an aid in converting a serious BASIC program, this is a severe limitation. Granted, file handling procedures probably are the biggest and most difficult to explain variable among BASIC dialects. But a book claiming to be "an encyclopedia of the BASIC computer language" should definitely address the subject in some detail.

The BASIC Handbook fills an important need in every programmer's library. It is a good reference for both the novice and expert, even though it is not complete.☐

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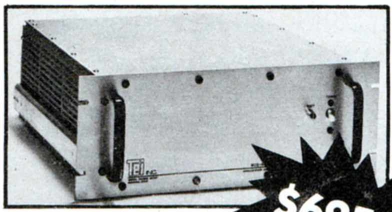

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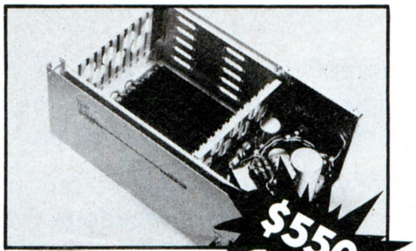

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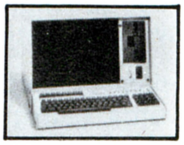

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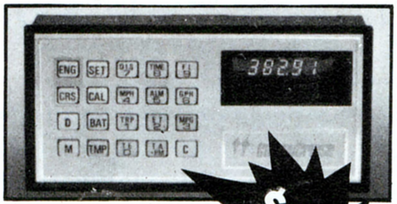

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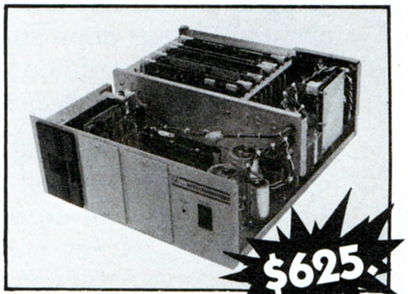

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The Pascal Notebook
Chapter 3

By Henry Davis, Associate Editor

Road Map — Chapter 3

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Data types and associated methods of denoting structure comprise the subject matter for Chapter Three.

While the syntax of control, and indeed all structures, is important from the compiler writer's point of view, data structures are perhaps the most important facility from the programmer's standpoint. Programming languages gain much of their power and elegance from the ease with which you can represent the physical world by abstractions of information. These abstractions must allow the selection of relevant data about the real world from a set of data available in the computer. The selected data set then contains the data considered necessary to solve a problem.

Computer data structures use multiple levels of abstraction. The first level uses a coded (in the sense of a binary representation) form of reality to allow real events to be represented in a storage media. By specifying a means of selecting relevant data, data structures also reduce the facts under consideration. This adds a second layer of abstraction to data and data structures.

Choosing an abstraction of reality (data structure) is a problem-driven task; the data set must reflect and represent the real situation. This choice is directly influenced by the tools available to define data structures. It is apparent that a basic set of abstractions common to many problem areas makes the programming task easier and more reliable. The actual representation in the computer memory is of little consequence to the user, providing that it is reasonable for his purposes.

Even though data abstraction is desirable, the point at which you cease to add new representations is not obvious. For example, it seems reasonable to expect some way of using integers, but is it reasonable to include days of the week, given names, or geometric shapes? Since the informal study of compilation in Chapter 1 provided a good basis for determining control structures, let's begin with the implied data types and structures used in the control structures and the syntax-graph-to-program translation.

Several of the control constructs use a "B" in their form which may have only two values. B is a variable of the standard primitive type Boolean (a standard primitive type is a built-in feature of a computer). For microprocessors, standard primitive types include Boolean (logical), integer, and character types.

The two permissible values of the standard primitive type Boolean are true and false. These two values are referred to by the identifiers true and false. Without facilities to modify or dynamically determine the relative truth or falsehood of an expression, many of the control structures reduce to degenerate forms which either always or never execute. Values for B can be determined at runtime by using expressions.

Three Boolean operators are defined in Pascal. They are conjugation ("and"), union ("or"), and negation ("not"). Actually, only two of these operators, negation and either of the other two, are necessary since they form a functionally complete Boolean algebra. This means that any Boolean function (expression) can be realized using only those two operators. The third operator is included for the sake of convenience; it is often easier to write in one form than the other. Using both operators also aids in achieving program clarity.

Table 2.

P	Q	Not P	Not Q	P and Q	P or Q
TRUE	TRUE	FALSE	FALSE	TRUE	TRUE
TRUE	FALSE	FALSE	TRUE	FALSE	TRUE
FALSE	TRUE	TRUE	FALSE	FALSE	TRUE
FALSE	FALSE	TRUE	TRUE	FALSE	FALSE

P and Q are Boolean variables in the usual mathematical sense. The negation of a variable is indicated by a prefix of " ". Conjunction (the logical function "and") and disjunction (the logical function "or") are represented by NOT and OR respectively. Later, we'll use many of the Boolean operators in conjunction with set operations.

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Table 2 defines the results of the Boolean operators, which are not particularly spectacular at this point. This situation is greatly improved when the results of any comparison are defined as Boolean.

Example E9

For example, let p be a Boolean variable and $x=2$, $y=3$ be integers, then

E9.1 $x=y$ is false
E9.2 $x<4$ is true
E9.3 $x>y$ is false
E9.4 $p := x=y$ assigns the result of $x=y$ (false) to p
E9.5 $p := (x<y) \wedge (x\leq y)$ assigns the result of $(x<4) \wedge (x\leq y)$ to p. This can be broken down into "true$\wedge$ true" which is true.

Table 3.

=	**equal**
<>	**not equal**
<=	**less than or equal**
<	**less than**
>	**greater than**
>=	**greater than or equal**

Table 3 details the comparison operators allowed in Pascal. Notice that by using the relational operators it is possible to define all sixteen Boolean operations. For example, "implication" becomes $p<=q$, "equivalence" is $p=q$, and "exclusive or" is $p<>q$.

The facility to easily handle characters is implied by the parsing definition. This is especially important because the most basic data handled by any compilers are the characters which make up the printable symbols of the language. Thus it is appropriate that Pascal includes a standard type for characters. The use of the word "standard" is somewhat misleading since there is no universally accepted character set. For the remainder of this series it is assumed that we will be using the ASCII character set of ninety-five graphic (printable) characters and thirty-three control characters. In order to define the relational operators for the character set, several properties are required.

D5. The letters have a lexicographic ordering. This means that "A" is less than "Z" as in a dictionary ordering. The ten digits are similarly ordered with "0" less than "9".
D6. A non-printing blank character is included in the set of characters (b̸ will denote the blank character when necessary to differentiate each occurrence in this text).

The last standard primitive data type implied by compiler writing involves representation of machine code by integers. We'll see this topic later but for now let's define the standard type integer. Integers are a subset of the whole numbers. The exact range is not generally implied by a language description, but rather an implementation restriction. Most often this restriction is made for the sake of convenience. Like the standard type Boolean, integers require operations to make valid expressions. Without these operations the type integer is next to worthless.

Because it is inconvenient and error producing to learn a new set of rules for arithmetic, we will assume that the ordinary laws of integer arithmetic apply. The four basic mathematical operators for addition (+), subtraction (−), multiplication (*), and division (DIV) are defined for integer arithmetic. Division results in an integer augand (ignores any remainder). Now if you consider positive integers M and N:

$$M-N < (M \text{ DIV } N)*N \leq M$$

The remainder of the division M DIV N can be obtained using the MOD operator:

(M DIV N)*N + (M MOD N) = M

The category of type "real" completes the standard primitive types. It is included in addition to integers since integers have a small range while reals include a greater range, but without exact representation. Integers are by definition exact. Real arithmetic allows all integer operators but denotes real division by a slash (/).

The four standard data types of integer, real, char (character) and Boolean form the building blocks for data structures. Since we are interested in general purpose languages and not compiler specific languages, a means of adding basic data types for compilers will aid in the programming task. This is facilitated by allowing type definition by enumeration. The general form is:

type t = (c1,c2,. . .cn)

where t is the new data type and c1,c2,. . .cn are the allowable values.

Example 10

E10.1 type shape = (circle,square,triangle)
E10.2 type color = (red,blue,green)
E10.3 type sex = (male,female)

Note that defining a new type introduces a new type identifier and a set of identifiers corresponding to the values of the new type. In order to maintain generality, the ordering of the new type's value is explicit in the ordering of the enumeration. Now all that's needed is a way to build new data types (structures) using these basic data types.

So far all the data types discussed have been unstructured. They are called unstructured because they can't be broken down into more elementary types. The data types we'll consider now are termed structured; they are made up of the primitive data types.

Perhaps the most common structured data type is the array. Part of the reason why it is so widely used is that it is the only structured type available in most languages, including FORTRAN and BASIC. Arrays have the advantage, and disadvantage, that they are homogeneous random-access structures. Homogeneous means that all components in the structure are of the same type (known as the base type). Random access allows the components to be accessed in any order with equal availability. An array is defined by: type T = array [I] of T_{BASE}.

Example E11

Examples of array definition will clarify this discussion.

E11.1 type ROW = array [1. . .100] of integer
ROW is an array of integers with indices from 1 to 100.
E11.2 type BUFFER = array [1. . .80] of char
BUFFER is an array of 80 characters.

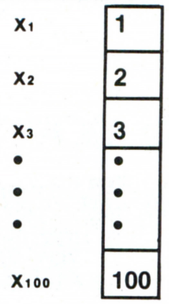

Figure 3.

Figure 3 illustrates an array of type ROW with the index in each array position.

Values may be assigned to the elements of an array by using an array constructor with an assignment statement. To assign values V_1 to V_n to a structured value, X, simply write:

$$X := T(V_1, \ldots, V_n)$$

where T is the type. Thus the following implements the array of Figure 3:

X: =ROW(1,2,. . .,100)

Getting initial values into an array (or other structure) is just the beginning. The real use of arrays is in selection. Each item can be individually accessed by the index. To indicate the ith element of the structure X, the index is postfixed to the array name and enclosed in square brackets. So X [i] refers to the ith element of the array named X.

PROGRAM 2

```
VAR X: ARRAY [1. . .N] of T; (*N>0*)

i:= 0;

REPEAT i:= i+1 UNTIL (X [i] = J)V(i = N);

IF X [i]<> J THEN NOT FOUND
```

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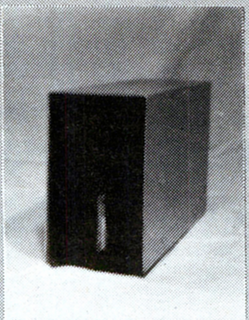

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Element E12

```
E12.1   X [1] :=2    assigns the value 2 to the number
                     one element of X.
E12.2   X[i]:= X[i] + 1    replace X[i] by X[i] plus 1
```

To see how the index is used, see Program 2. The program finds the smallest (least) value of i such that X [i] = J.

Up to this point the data structures have been similar to those found in other programming languages. In fact, Pascal simply generalizes the available means for handling data. However, the RECORD structure may be new. The most general form of any data structure is one in which arbitrary elements (including structured types) can be joined together in an arbitrary manner. The general form of a record definition is:

```
type T  = RECORD S1 : T1;
                 S2 : T2;

                 Sn : Tn
          END
```

The definition of a complex number has often been used as an example of a record. A complex number consists of two real numbers, one for the real part, and the other for the imaginary part.

Element E13

```
type COMPLEX  = RECORD REALPART: REAL;
                       IMAGPART: REAL
                END
```

Business applications often include a date record, used for sorting data. Such a record composed of year, month, and day can be defined as:

Example E14

```
type DATE  = RECORD YEAR : 1...2000;
                    MONTH : 1...12;
                    DAY : 1...31;
             END
```

Values may be assigned to a complex variable V as in the following:

Example E15

```
V:= COMPLEX (4.7,9.6)
```

In order to access an individual component of a record, simply write the variable (record) name suffixed with the record selector S_i. For example, the real part of the complex variable, V, may be accessed by:

Example E16

```
V.REALPART
```

Because this selector form is verbose and forces re-evaluation of the storage address, Pascal includes a notational variant to abbreviate the source text and avoid address re-evaluation. The statement WITH r DO S indicates that the selectors of r may be used in S without explicitly writing r.

The last form of the record structure allows conditional definition of records. For example, both polar and cartesian coordinates of geometry can be considered to be variants of the type coordinate.

Example E17

```
type COORDINATE  =
     RECORD CASE KIND : (CARTESIAN,POLAR) OF
            CARTESIAN : (x,y: REAL);
            POLAR : (r: REAL; θ : REAL)
     END
```

While Example E17 illustrates variant records with distinct types are involved, it is legal and reasonable to define records in which portions of the record are identical but with diverging subparts of the record. The general form of such a record is:

```
type T =
    RECORD S1:T1;...;Sn-1:Tn-1;
        CASE Sn:Tn OF
            C1:(S1,1:T1,1;...;S1,n1:T1,n1)
               •
               •
            Cm:(Sm,1:Tm,1;...;Sm,nm:Tm,nm)
    END
```

Obviously, the variant record structure requires care in programming, for it is possible to attempt to access components that are irrelevant and indeed not available because the selector may not be included in every record.

For example, a data structure used in a statistical study of individuals may include different data based on sex; metrics dealing with beard length and color may not be appropriate if the individual is a female. In order to save storage space and allow flexibility in programming, it is reasonable to refer to PERSON.BEARD.LENGTH. if the individual is a male but leave the result undefined or illegal if the person is female. Presumably, the program flow follows two different paths for sex-specific traits.

Pascal adds a third fundamental data structure unique in many respects. The set structure defines a finite set of elements. The general form is written as:

type T = SET OF T_0

Now a variable, X of type T, is restricted to values in the set as defined by T_0. Examples of the set definition include:

Example E18

```
E18.1   type DIGIT = SET OF 0...9
E18.2   type CHARACTERSET = SET OF CHAR
E18.3   type COLORWHEEL = SET OF COLOR
```

E18.1 defines a set type "DIGIT" with elements 0,1,2,3, 4,5,6,7,8, and 9. E18.2 uses the standard set of characters as defined by the standard primitive type CHAR. E18.3 is based on a set defined by a scalar type "COLOR"

What really makes the set type worthwhile is the set of allowable set operations. Four elementary operators are defined for sets of all types:

set intersection	*
set union	+
set difference	−
set membership	in

Set intersection yields only those elements present in both sets, set union results in elements present in either set, and set difference produces a set of elements present in only one set. Example E19 illustrates the meaning of these operators.

Example E19

```
E19.1   SET S = A,B,C,D   ,SET T = C,D,E,F
E19.2   S*T = C,D
E19.3   S+T = A,B,C,D,E,F
E19.4   S−T = A,B,E,F
E19.5   A in S is true
E19.6   F in S is false
E19.7   257 in T is false
```

The operator precedence is defined in Table 4.☐

Table 4.

a*b + c = (a*b) + c
a − b*c = a − (b*c)
a − b*c = (a − b) + c
x in a + b = x in (a + b)

The author can be contacted at American Microsystems, Inc., 3800 Homestead Road, Santa Clara, CA 95051.

My TRS-80 Likes Me

When I Teach Kids How to Use It

By Bob Albrecht

The Radio Shack TRS-80 is a great machine for teaching kids how to use, program and enjoy computers. I've been helping kids learn how to enjoy BASIC for 16 years. For this purpose (helping kids enjoy BASIC), the TRS-80 is the best computer I have used, especially if the learners are elementary school children.

I am not saying the TRS-80 is the best computer for all purposes. I am saying that I think the TRS-80 is the best computer that I have used (so far) to teach elementary school children, grades 4, 5 and 6, how to understand and enjoy BASIC.

So, if you have a TRS-80, grab a bunch of kids and help them learn how to understand simple programs in TRS-80 BASIC. Here are ideas on how to go about it, including numerous short programs that many kids have enjoyed. Most of these programs will work in either Level II or Level II BASIC. A few are written in Level II; you can easily change them to Level I.

Think of the following as an outline of things to do. You explain what is happening, answer questions, invent variations on my ideas and (of course!), use your own ideas. But don't do the typing. Let the kids do all the hands-on stuff. Be patient — let them make mistakes, correct their own mistakes, and above all, encourage them to experiment!

Show the young learners how to hook up the TRS-80 and turn it on. Show them how to clear the screen. Start each "episode" with a clear screen. Tell them about the prompt (>) and the cursor (—).

When you see this
it is your turn
to type. ⟶

Have someone clear the screen, type his or her name, then press the ENTER key. The TRS-80 will probably type an error message. Explain that "The TRS-80 doesn't understand you." Never mind — tell them not to worry about occasional misunderstandings.

Kids are fascinated by their names. In this article, we will do lots of things with names. Start with direct statements such as the following. You will have to remind them several times to press ENTER after typing a statement.

```
PRINT "LUCY"
PRINT "CHARLIE"
PRINT "SNOOPY"
PRINT "LUKE SKYWALKER"
```

and so on. Let every kid do this.

Now the fun begins. Have each kid enter and run a short two-line program which will fill the screen with a name.

```
10 CLS
20 PRINT "LUCY";
30 GOTO 20
```

When the above program is RUN, the screen quickly fills up with the name 'LUCY'. Then the names seem to move to the right (an optical illusion). Experiment with names and with other characters. Take your time; keep it slow and easy. Let the kids set the pace.

Of course, you will show them how to interrupt a program by pressing the BREAK key. Also show them how to LIST a program and how to change only Line 20 in order to put a different name on the screen.

In Level II BASIC, a syntax error causes the TRS-80 to go into Edit Mode. Press Q to get out — don't get into heavy editing this early in the game.

Make it easier to change the name. Tell them about "boxes" such as A$, B$, etc., which can hold names or other strings of characters.

```
10 CLS
20 LET A$="LUCY"
30 PRINT A$;
40 GOTO 30
```

Try other "boxes" such as B$, C$, N$, etc. Use single letter variables only; it will save you lots of time. If you are a "computer scientist" or "computer hobbyist" please remember: kids aren't.

Still easier. Use the INPUT statement.

```
10 CLS
20 INPUT A$
30 PRINT A$ ;
40 GOTO 30
```

Let everyone use this program.

Slow down the action. Use an "empty" FOR-NEXT loop as a time delay.

```
10 CLS
20 INPUT A$
30 PRINT A$ ;
40 FOR Z = 1 TO 100
50 NEXT Z
60 GOTO 30
```

The FOR-NEXT loop (Lines 40 and 50) causes the TRS-80 to count from 1 to 100. Kids are usually surprised at how fast the computer can count to 100. Try other numbers (instead of 100) in the FOR statement. Slower: Use numbers greater than 100. Faster: Use numbers less than 100.

How about a variable time delay?

```
10 CLS
20 INPUT A$
30 PRINT A$ ;
40 LET T = 100
50 FOR Z = 1 TO T
60 NEXT Z
70 GOTO 30
```

Now we can blink a name on and off.

```
 10 CLS
 20 INPUT A$
 30 CLS
 40 PRINT A$ ;
 50 LET T = 100          Name ON
 60 FOR Z = 1 TO T
 70 NEXT Z
 80 CLS
 90 LET T = 100
100 FOR Z = 1 TO T       Name OFF
110 NEXT Z
120 GOTO 30
```

To slow down the action, make T > 100. To speed it up, make T < 100.

Our program has two identical time delays. Great opportunity to introduce SUBROUTINES.

```
 10 CLS
 20 INPUT A$
                     Save room for Line 30
 40 CLS
 50 PRINT A$ ;       Name ON
 60 GOSUB 100
 70 CLS
 80 GOSUB 100        Name OFF
 90 GOTO 40
100 LET T = 100
110 FOR Z = 1 TO T
120 NEXT Z
130 RETURN
```

Take lots of time to explain this one.

Well, let's not wear out the upper left hand corner of the screen. Tell them about PRINT @ (or PRINT AT in Level I BASIC). In the above program, replace Line 50 with one of these. In fact, do all of them, one by one.

```
50 PRINT @0, A$ ;
50 PRINT @32, A$ ;
50 PRINT @64, A$ ;
50 PRINT @500, A$ ;
```

and so on.

Of course, tell them that there are 1024 print positions numbered from 0 to 1023. Make a map of the screen showing where the print positions are located. Below is a handy program for putting your name where you want it on the screen. Explain the use of strings within INPUT statements.

```
 10 CLS
 20 INPUT "WHAT IS YOUR NAME";A$
 30 INPUT "WHERE SHOULD I BLINK IT";N
 40 CLS
 50 PRINT @N,A$;       Name ON
 60 GOSUB 100          at position N

 70 CLS                Name OFF

 80 GOSUB 100          (everywhere)

 90 GOTO 30
100 LET T = 100
110 FOR Z = 1 TO T
120 NEXT Z
130 RETURN
```

As always, take time and make sure everyone understands this program. Remember, they are learning how to read and understand a language. The first step in learning how to create original stuff in a language is to first understand the language!

The next program causes a name to scamper back and forth across the screen:

```
10 CLS
20 INPUT "WHAT IS YOUR NAME";A$
30 FOR K = 0 TO 1023
40 CLS
50 PRINT @K,A$;
60 NEXT K
70 GOTO 30
```

Too fast? Probably — so, you put in a time delay.

THE RND FUNCTION

One of the nicest things about the TRS-80 is the way the RND function works. It gives integer random numbers in a way that is easy to understand and use by people who are not math wizards. Most other BASICs give random numbers between 0 and 1. I really can't understand why — most applications (especially games!) require integer random numbers. In most BASICs, much mind boggling math is required to get the desired integer random numbers.

Desired random numbers: 1 or 2

```
     TRS-80:  RND(2)
Most others:  INT (2 * RND(1))+1
```

Desired random numbers: 1, 2 or 3

```
     TRS-80:  RND(3)
Most others:  INT (3 * RND(1))+1
```

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Desired random numbers: 1, 2, 3, 4, 5, 6
TRS-80: RND(6)
Most others: INT (6 * RND(1))+1

Desired random numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
TRS-80: RND(10)−1
Most others: INT (10 * RND(1))

Got the idea? It goes like this. If n is a positive integer, then RND(n) will give random positive integers in the range, 1 to n. RND(0) will give random numbers in the range, 0 to 1, just like all the other computers.

Do some experiments.

```
10 CLS
20 PRINT RND(2);
30 GOTO 20
```

```
10 CLS
20 PRINT RND(3);
30 GOTO 20
```

```
10 CLS
20 PRINT RND(6);
30 GOTO 20
```

```
10 CLS
20 PRINT RND(10)−1;
30 GOTO 20
```

OK, so RND gives random numbers. So what? Well, let's use them to put a name here, there and everywhere on the screen. Here for a moment, there for a moment, somewhere else for a moment.

```
10 CLS
20 X = RND(1023)
30 PRINT @X,"LUCY";
40 T = 100
50 FOR Z = 1 TO T           Time delay
60 NEXT Z
70 GOTO 10
```

Explain Lines 20 and 30 carefully. Line 20 gives a random integer from 1 to 1023, inclusive, and puts this number in box X. Line 30 causes the name "LUCY" to be printed at position X on the screen. Lines 50 and 60 are a time delay. Change Line 40 to decrease or increase the delay. Faster: Make T < 100. Slower: Make T > 100.

Let each kid change Line 30 to his or her name. To make it easier, try the following program.

```
10 CLS
20 INPUT "WHAT IS YOUR NAME";N$
30 CLS
40 X = RND(1023)
50 PRINT @X, N$;
60 T = 100
70 FOR Z = 1 TO T
80 NEXT Z
90 GOTO 30
```

As usual, slowly and patiently explain what is happening to your eager young learners. If they say, "What if . . .?" then you say, "Try it and find out!"

Next time, more random stuff. Also, we will venture into TRS-80 graphics for kids.☐

This series originally appeared in Calculators and Computers *magazine. The author may be contacted at P.O. Box 310, Menlo Park, CA 94025.*

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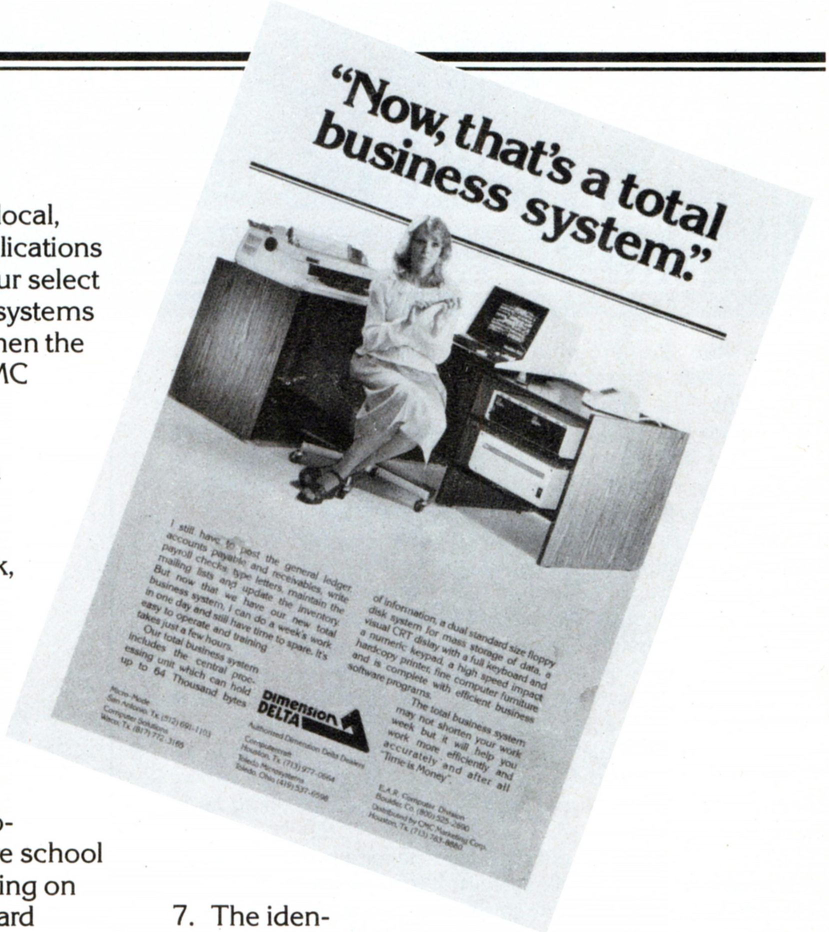

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CIRCLE INQUIRY NO. 64

Discrete Model Simulation Program

By Dennis E. Bahr

The simulation program described can be used to simulate causal systems described as coupled first order differential equations. The simulation program and the user statements are written in BASIC which is supported by most minicomputer and microcomputer systems. Function calls are used extensively, providing the user with a practical means of implementing the equations of the model into computer statements. A maximum of twenty-five coupled differential equations may be simulated at one time.

A very practical method of using the digital computer to model physical systems and solve the associated differential equations is to use the ubiquitous computer language called BASIC. This program is supported by nearly every minicomputer and microcomputer and provides the user with a very convenient way of implementing the equations for the model. Other simulation programs currently available include AUTORK and CCSL; however, these programs are written in FORTRAN and must typically be run using large computer systems.

Often the laboratory collecting the data for a model may have a small inhouse computer system. It then becomes very convenient to have a resident simulation program which could be used to test the model as soon as the data are available.

DESCRIPTION

A computer program which meets these criteria is called a DISCRETE MODEL SIMULATION PROGRAM (DMSP). A block diagram of the structure of DMSP is shown in Figure 1 and a complete listing of DMSP can be found in Program 1.

The main program contains five input statements where the user can enter the program constants. These constants are entered during run time and are not altered during the execution phase. Three separate sections are provided for the user to enter the description of the system to be modeled. The initialization section contains the integrator initial conditions as well as any replacement statements which are used for multiple runs. To display the resulting solution the user places one or more function calls to one of the output functions in the output section.

The equations which describe the system are written as coupled first order equations and inserted in the equation section. The user can use any label for variable names except that it must not begin with the letter Z which is exclusively reserved for DMSP.

The program is function intensive and requires a BASIC which supports multi-line functions. This dependence on functions allows the user to execute some rather complex operations using function calls, making his task relatively easy.

DMSP MAIN PROGRAM

I. Program Constants
  A. Time Increment
  B. Output Interval
  C. Start of Output
  D. End of Output
  E. Number of Runs
II. Model Description
  A. Initial Conditions
  B. Output Statements
  C. System Equations

FUNCTION FNB
Places bounds on
system variables
(hard limiter)

FUNCTION FNI
Runge-Kutta
Integrator
(4th order)

FUNCTION FNW
Periodic
waveform
generator

FUNCTION FNG
Graphs system
variables
vs. time

FUNCTION FNP
Plots any variable
vs. any other
variable

FUNCTION FNT
Types lists of
variable values

Figure 1.

The FNB function acts as a hard limiter by not allowing the variable passed to it to exceed certain limits. A generalization of this function call appears as follows:

Bounded Variable = FNB(Variable,Lower Limit,Upper Limit)

If the variable's value is less than the lower limit, the function returns the lower limit and if the variable is greater than the upper limit, the upper limit is returned. If the value of the variable is between the two limits, the variable's value is returned.

One of the best known and most used methods for numerical integration is that of the Runge-Kutta integration formulas. These formulas are self starting, single step procedures which involve only first-order derivative evaluations and are as accurate as higher order Taylor formulas. The FNI function utilizes the fourth order integrating formula that was developed by Kutta in 1901.

The function requires eight passes through the system used for each time increment. Four of the passes are used to calculate the required four formula constants while the other four passes are used to update the system equations. These eight passes through the FNI function are interlaced. To integrate a variable, one uses a BASIC statement as shown below:

```
Integ Output=FNI(Integ Input,Integ Output)
```

The above statement is very easy to understand if one remembers that the integral of a function is the integral of the sum of the inputs to the integrator plus an initial condition. Because the user statements are not pre-compiled or pre-interpreted, the user must sort his statements such that all variables are defined before they are used. All FNI function calls must appear at the bottom of the list of the system equations. These criteria require some care in writing the equations, but cause no problems for most simulations.

To facilitate the generation of periodic functions a function routine has been included to generate rectangular waveforms. The function called FNW requires three arguments and a general call is shown below:

```
Dummy=FNW(Start,Stop,Period)
```

The start and stop arguments set the on time of the waveform and the period of the waveform is set by the argument called period.

DMSP is written to support both a console and a line printer. All inputs such as program constants and user generated software as well as outputs such as error messages use the console device. The outputs which are generated by the output functions such as plots, graphs and tabulated lists are done on the line printer.

The function called FNG can be used to generate graphs containing up to five variables with time as the independent variable. The function call requires three numerical arguments and one string argument as shown below:

```
Dummy=FNG(Variable,Min Value,Max Value,"Variable Name")
```

The function generates a line of output each time a pass is made through the output section. Data is not stored prior to being graphed and for this reason the limits must be passed in the calling sequence. The function returns a value of zero when a proper call is made. If a "soft error" is encountered, such as an attempt to graph six variables, a minus one is returned. The user can test for this by looking at the variable called Dummy.

The function FNP is similar to the graphing function except that only two function calls are allowed in the output section. The first call passes the dependent variable information while the second call passes the independent variable information. These function calls appears as follows:

```
Dummy=FNP(Dep Var,Min Value,Max Value,"Dep Name")
Dummy=FNP(Indep Var,Min Value,Max Value,"Indep Name")
```

This function must sort and store the data before generating the plot because the dependent variable may not be a function of the independent variable. A maximum of 200 data points may be plotted at one time. If an attempt is made to plot more than this, the extra data will simply be ignored.

Many times it is more meaningful to have lists of the variable values. DMSP allows this option with the FNT function.

```
Dummy=FNT(Variable,"Name")
```

The function call requires the variable value and name which is used to identify the variable on the resulting printout. As many as five variables can be listed during any particular run.

EXAMPLE

One of the best examples which can be used to demonstrate how DMSP is used is that of Van der Pol's equation. The Van der Pol equation is given as:

$$X'' - E(1 - X^2)X' + X = 0$$

This equation describes a system which is, in effect, a non-linear oscillator and approaches a linear oscillator as E approaches zero. The Van der Pol oscillator with small values of E appears as an almost ideal image of the harmonic oscillator; however, in reality it contains the germ of a complicated structure consisting of an infinite spectrum of amplitude and phase modulations which escapes observations. This phenomenon becomes increasingly complex as E increases.

The solution to this equation is a stable limit cycle of self-sustained oscillations. An important feature of this type of oscillator is that the limit cycles do not depend on the initial conditions, but rather entirely on the system parameters and the differential equation. Another interesting point is that this differential equation is self starting and requires no forcing function.

Since we are using a digital computer to do our modeling, we need not worry about amplitude and time scaling. The first thing that is done is to rewrite the equation with the highest order derivative on the left hand side of the equation.

$$X'' = E(1 - X^2)X' - X$$

We now make the following change of variables:

$$X2 = X''$$
$$X1 = X'$$
$$X0 = X$$

The equation now becomes:

$$X2 = E(1 - X^2)X1 - X0$$

This can be written in BASIC as follows:

```
6000  X2=E*(1-X0^2)*X1-X0
```

Generation of the variables X1 and X0 requires multiple integration of the variable X2. This is accomplished using the FNI function call.

```
6010  X1=FNI(X2,X1)
6010  X0=FNI(X1,X0)
```

The initial conditions necessary to solve the equation are written as replacement statements and placed in the initial condition section.

```
2000  X0=0.4
2010  X1=0
2020  E=1
```

To plot the variable X1 as a function of the variable X0 one sets up two plot function calls as follows:

```
4000  P=FNP(X1,-4,+4,"VELOCITY")
4010  P=FNP(X0,-2,+2,"POSITION")
```

The equation is now ready to be solved. When the program is run it will respond by asking the user for the program constants. An actual run would generate the following output on the operator's console:

```
>READY

RUN

TIME INCREMENT? .1
OUTPUT INTERVAL? .1
START OF OUTPUT? 0
END OF OUTPUT? 20
NUMBER OF RUNS? 1
ADJUST PRINTER TO FIRST LINE OF PAGE, OK?

SIMULATION USING DMSP IS COMPLETE

>READY
```

During run time the line printer will generate the plot as specified by the two calls to the plot function. This plot is shown in Figure 2.

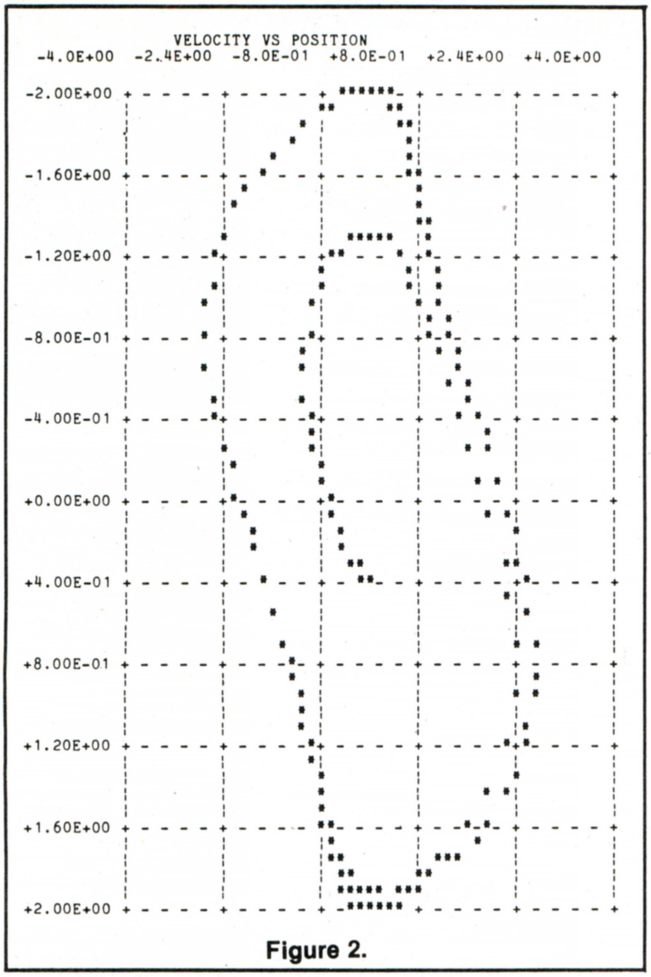
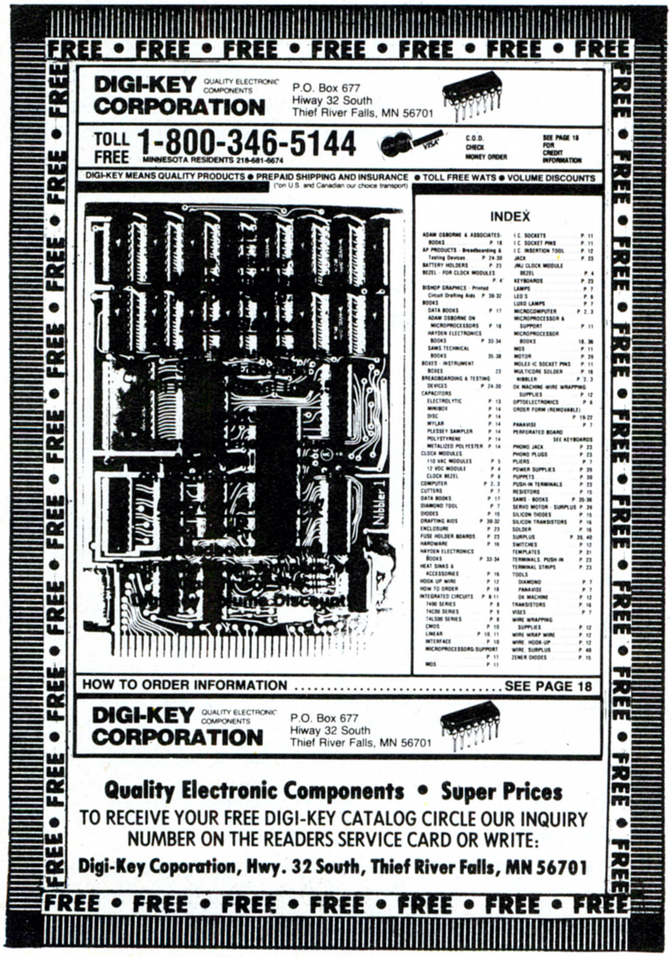


Figure 2.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Should the user decide to graph the variable X0 and X1 as a function of time, he can do so by replacing statements 4000 and 4010 with the following statements:

```
4000 G=FNG(X0,-2,+2,"POSITION")
4010 G=FNG(X1,-4,+4,"VELOCITY")
```

The graph generated by the line printer is shown in Figure 3.

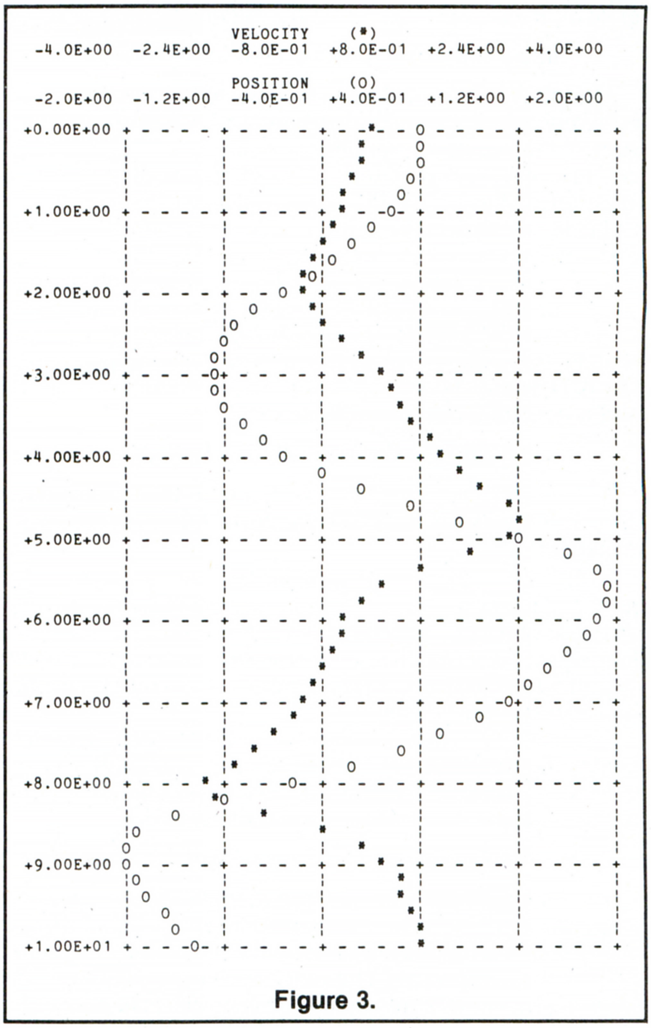

Figure 3.

CONCLUSION

DMSP is a simulation program which can solve linear and nonlinear differential equations. It can be run on small computer systems and is relatively easy to use. The language has been successfully tested on the BASICs written by Technical Design Laboratories and North Star Computers. The North Star version required some conversion. These BASICs are representative of most extended microcomputer BASICs.

Running with a BASIC compiler and using a microcomputer with hardware arithmetic would speed the execution time from minutes to seconds. A cardiovascular model with 15 coupled first order differential equations has been run successfully.☐

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Program follows on Page 99

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LM723H/N	.50
LM733N	.67
LM741CH	.35
LM741N	.25
LM747H/N	.62
LM748N	.35
LM1303N	.82
LM1304	1.10
LM1305	1.27
LM1307	2.00
LM1310	2.75
LM1458	.47
LM1800	1.75
LM1812	7.50
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LM2902	1.50
LM3900N	.60
LM3905	1.75
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NE550N	.65
NE555V	.43
NE556A	.79
NE565A	1.00
NE566V	1.50
NE567V	1.20
NE570B	5.00
NE571B	5.00
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78L08	.60
78M05	.85
75108	1.75
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CD4000	.16
CD4001	.28
CD4002	.28
CD4006	1.10
CD4007	.28
CD4008	.28
CD4009	.39
CD4010	.39
CD4011	.28
CD4012	.28
CD4013	.36
CD4014	.86
CD4015	.86
CD4016	.36
CD4017	.94
CD4018	.94
CD4019	.28
CD4020	1.02
CD4021	1.02
CD4022	.86
CD4023	.28
CD4024	.75
CD4025	.28
CD4026	1.51
CD4027	.36
CD4028	.79
CD4029	1.02
CD4030	.28
CD4035	1.02
CD4040	1.02
CD4042	.71
CD4043	.63
CD4044	.63
CD4046	1.67
CD4049	.36
CD4050	.36
CD4051	1.13
CD4060	1.42
CD4066	.71
CD4068	.40
CD4069	.40
CD4070	.40
CD4071	.28
CD4072	.28
CD4073	.28
CD4075	.28
CD4076	1.75
CD4078	.40
CD4081	.28
CD4082	.28
CD4116	.47
CD4490	5.50
CD4507	1.00
CD4508	4.25
CD4510	1.02
CD4511	.94
CD4515	2.52
CD4516	1.10
CD4518	1.02
CD4520	1.02
CD4527	1.51
CD4528	.79
CD4553	3.50
CD4566	2.25
CD4583	4.50
CD4585	1.10
CD40192	3.00
74C00	.28
74C04	.33
74C10	.28
74C14	2.10
74C20	.28
74C30	.28
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74C74	.75
74C76	1.40
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74C160	1.44
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74C923	5.50
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8096	.65
8097	.65
8098	.65
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8T10	4.50
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8T20	5.50
8T23	3.10
8T24	3.50
8T25	3.20
8T26	1.69
8T28	2.75
8T97	1.69
8T98	1.69

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2102-1	.95
2102AL-4	1.60
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21F02	1.25
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2107B-4	3.75
2111-1	3.75
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18	.27	36	.58
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2N3904	.18
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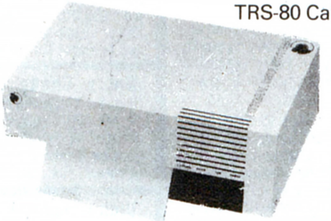

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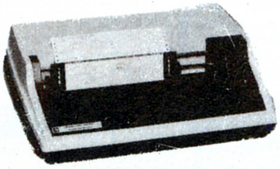

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PROGRAM LISTING

```
1000 REM **************************************************
1010 REM *                                                *
1020 REM *       DISCRETE MODEL SIMULATION PROGRAM        *
1030 REM *                                                *
1040 REM *                  VER. 061478                   *
1050 REM *                                                *
1060 REM *                      BY:                       *
1070 REM *                 DENNIS E BAHR                  *
1080 REM *                                                *
1090 REM **************************************************
1100 REM THIS IS THE MAIN PROGRAM
1110 DIM Z0(500),Z(8,25),Z$(5),Z0$(52),Z1$(52)
1120 GOSUB 8000
1130 Z$(1)="*"
1140 Z$(2)="O"
1150 Z$(3)="X"
1160 Z$(4)="@"
1170 Z$(5)="#"
1180 INPUT "TIME INCREMENT";Z0(1)
1190 INPUT "OUTPUT INTERVAL";Z0(2)
1200 INPUT "START OF OUTPUT";Z0(3)
1210 INPUT "END OF OUTPUT";Z0(4)
1220 INPUT "NUMBER OF RUNS";Z0(5)
1230 INPUT "ADJUST PRINTER TO FIRST LINE OF PAGE, OK";Z0(6)
1240 Z0(6)=1
1250 Z0(7)=0
1260 Z0(8)=1
1270 Z0(9)=0
1280 Z0(0)=1
1290 T=0
1300 LPRINT
1310 REM **************************************************
1320 REM *** PLACE INITILIZATION STATEMENTS HERE ***
3000 REM ##################################################
3010 Z9=INT((Z0(4)-Z0(3))/Z0(2)+1.5)
3020 FOR Z1=-Z0(3)/Z0(2) TO Z9
3030 Z0(10)=1
3040 IF Z1<0 GOTO 5020
3050 REM **************************************************
3060 REM *** PLACE OUTPUT STATEMENTS HERE ***
5000 REM ##################################################
5010 Z0(8)=-1
5020 FOR Z2=1 TO Z0(2)/Z0(1)
5030 FOR Z3=1 TO 8
5040 Z6=-1
```

```
5050 REM **************************************************
5060 REM *** PLACE SYSTEM EQUATIONS HERE ***
7000 REM ##################################################
7010 Z0(9)=FNI(Z0(9),Z0(9))
7020 NEXT Z3
7030 Z0(7)=Z0(7)+1
7040 NEXT Z2
7050 NEXT Z1
7060 Z0(10)=INT(Z0(0)/66+1)*66-Z0(0)
7070 FOR Z1=1 TO Z0(10)
7080 IF Z0(10)<65 THEN LPRINT
7090 NEXT Z1
7100 Z0(6)=Z0(6)+1
7110 IF Z0(6)<=Z0(5) GOTO 1260
7120 PRINT:PRINT
7130 PRINT TAB(5);"SIMULATION USING DMSP IS COMPLETE"
7140 END
7150 REM --------------------------------------------------
8000 REM PROGRAM TO SET BOUNDS ON VARIABLES
8010 REM Z4 IS THE VARIABLE
8020 REM Z5 IS THE LOWER LIMIT
8030 REM Z6 IS THE UPPER LIMIT
8040 DEF FNB(Z4,Z5,Z6)
8050 IF Z4<Z5 THEN FNRETURN Z5
8060 IF Z4>Z6 THEN FNRETURN Z6
8070 FNEND Z4
8080 REM --------------------------------------------------
9000 REM RUNGE-KUTTA PROGRAM FOR 4TH ORDER INTEGRATION
9010 REM Z3 IS THE PASS NUMBER
9020 REM Z4 IS THE SUM OF THE INPUTS TO THE INTEGRATOR
9030 REM Z5 IS THE VARIABLE BEING INTEGRATED
9040 REM Z6 IS THE STATE VARIABLE NUMBER
9050 DEF FNI(Z4,Z5)
9060 Z6=Z6+1
9070 ON Z3 GOTO 9080,9230,9130,9230,9160,9230,9200,9230
9080 Z(2,Z6)=Z5
9090 Z(3,Z6)=Z0(1)*Z4
9100 T=Z0(1)*(Z0(7)+0.5)
9110 Z(1,Z6)=Z(2,Z6)+0.5*Z(3,Z6)
9120 FNRETURN Z5
9130 Z(4,Z6)=Z0(1)*Z4
9140 Z(1,Z6)=Z(2,Z6)+0.5*Z(4,Z6)
9150 FNRETURN Z5
9160 Z(5,Z6)=Z0(1)*Z4
9170 T=Z0(1)*(Z0(7)+1)
9180 Z(1,Z6)=Z(2,Z6)+Z(5,Z6)
9190 FNRETURN Z5
9200 Z(6,Z6)=Z0(1)*Z4
9210
```

```
Z(1,Z6)=Z(2,Z6)+(Z(3,Z6)+2.0*(Z(4,Z6)+Z(5,Z6))+Z(6,Z6))/6
9220 FNRETURN Z5
9230 FNEND Z(1,Z6)
9240 REM -------------------------------------------------
10000 REM PROGRAM FOR GRAPHING VARIABLES
10010 REM Z4 IS THE VARIABLE TO BE GRAPHED
10020 REM Z5 IS THE MIN ORDINATE VALUE
10030 REM Z6 IS THE MAX ORDINATE VALUE
10040 REM Z0$ IS THE LABEL FOR THE GRAPH
10050 DEF FNG(Z4,Z5,Z6,Z0$)
10060 IF Z0(10)>5 THEN FNRETURN -1
10070 IF Z0(8)<0 GOTO 10220
10080 IF LEN(Z0$)>15 THEN Z0$=LEFT$(Z0$,15)
10090 Z7=INT(30-LEN(Z0$)/2)
10100 LPRINT TAB(Z7);Z0$;SPC(4);"(";Z$(Z0(10));")"
10110 LPRINT TAB(6);
10120 Z0(11)=(Z6-Z5)/5
10130 FOR Z7=0 TO 5
10140 Z0(12)=Z5+Z0(11)*Z7
10150 LPRINT USING "+#.#^^^^";Z0(12);
10160 IF Z7<5 THEN LPRINT SPC(2);
10170 NEXT Z7
10180 LPRINT:LPRINT
10190 Z0(0)=Z0(0)+3
10200 Z8=0
10210 IF Z0(10)>1 GOTO 10490 ELSE GOTO 10350
10220 IF Z0(10)>1 GOTO 10490
10230 IF Z8>0 GOTO 10280
10240 Z0(13)=T-Z0(2)
10250 LPRINT USING "+#.##^^^^";Z0(13);
10260 Z8=5
10270 GOTO 10290
10280 LPRINT SPC(9);
10290 FOR Z7=0 TO 52
10300 LPRINT Z1$(Z7);
10310 NEXT Z7
10320 LPRINT
10330 Z0(0)=Z0(0)+1
10340 Z8=Z8-1
10350 FOR Z7=0 TO 52
10360 Z1$(Z7)=" "
10370 NEXT Z7
10380 IF Z8>0 GOTO 10460
10390 FOR Z7=3 TO 51 STEP 2
10400 Z1$(Z7)="-"
10410 NEXT Z7
10420 FOR Z7=1 TO 51 STEP 10
```

```
12180 NEXT Z7
12190 LPRINT
12200 Z0(0)=Z0(0)+1
12210 Z0(Z0(10)+13)=Z4
12220 Z0(13)=Z0(10)
12230 Z0(10)=Z0(10)+1
12240 FNEND 0
12250 REM -------------------------------------------------
13000 REM PROGRAM FOR PLOTTING VARIABLES
13010 REM Z4 IS THE VARIABLE TO BE PLOTTED
13020 REM Z5 IS THE MIN VALUE
13030 REM Z6 IS THE MAX VALUE
13040 REM Z0$ IS THE VARIABLE LABEL
13050 DEF FNP(Z4,Z5,Z6,Z0$)
13060 IF Z0(10)>2 THEN FNRETURN -1
13070 IF Z1>199 GOTO 13300
13080 Z0(11)=INT(1.5+(Z4-Z5)*50/(Z6-Z5))
13090 IF Z0(11)<0 GOTO 13140
13100 IF Z0(11)>52 GOTO 13140
13110 IF Z0(10)=2 GOTO 13190
13120 Z0(12)=Z0(11)
13130 GOTO 13300
13140 PRINT:PRINT:PRINT
13150 IF LEN(Z0$)>15 THEN Z0$=LEFT$(Z0$,15)
13160 PRINT TAB(4);"THE VARIABLE CALLED '";Z0$;
13170 PRINT "' HAS EXCEEDED ITS RANGE"
13180 END
13190 IF Z0(8)<0 GOTO 13230
13200 Z0(101)=Z0(12)
13210 Z0(301)=Z0(11)
13220 GOTO 13300
13230 FOR Z8=Z1 TO 1 STEP -1
13240 IF Z0(300+Z8)<=Z0(11) GOTO 13280
13250 Z0(301+Z8)=Z0(300+Z8)
13260 Z0(101+Z8)=Z0(100+Z8)
13270 NEXT Z8
13280 Z0(101+Z8)=Z0(12)
13290 Z0(301+Z8)=Z0(11)
13300 Z0(10)=Z0(10)+1
13310 IF Z1+1<Z9 THEN FNRETURN 0
13320 IF LEN(Z0$)>15 THEN Z0$=LEFT$(Z0$,15)
13330 IF Z0(10)>2 GOTO 13380
13340 Z0(13)=Z5
13350 Z0(14)=(Z6-Z5)/5.0
13360 Z1$=Z0$
13370 FNRETURN 0
13380 Z0$=Z1$+" VS "+Z0$
13390 Z7=INT(30-LEN(Z0$)/2)
13400 LPRINT TAB(Z7);Z0$
```

```
10430 Z1$(Z7)="+"
10440 NEXT Z7
10450 GOTO 10490
10460 FOR Z7=1 TO 51 STEP 10
10470 Z1$(Z7)="¦"
10480 NEXT Z7
10490 Z9=INT(1.5+(Z4-Z5)*50.0/(Z6-Z5))
10500 IF Z9<0 GOTO 10550
10510 IF Z9>52 GOTO 10550
10520 Z1$(Z9)=Z$(Z0(10))
10530 Z0(10)=Z0(10)+1
10540 FNRETURN 0
10550 PRINT:PRINT:PRINT
10560 IF LEN(Z0$)>15 THEN Z0$=LEFT$(Z0$,15)
10570 PRINT TAB(4);"THE VARIABLE CALLED '";Z0$;
10580 PRINT "' HAS EXCEEDED ITS RANGE"
10590 END
10600 FNEND 0
10610 REM -------------------------------------------------
11000 REM PROGRAM TO GENERATE RECTANGULAR WAVEFORMS
11010 REM Z4 IS THE START TIME
11020 REM Z5 IS THE END TIME
11030 REM Z6 IS THE PERIOD
11040 DEF FNW(Z4,Z5,Z6)
11050 Z6=T-INT(T/Z6)*Z6
11060 IF Z6<Z4 THEN FNRETURN 0
11070 IF Z6=>Z5 THEN FNRETURN 0
11080 FNEND 1
11190 REM -------------------------------------------------
12000 REM PROGRAM FOR TYPING VARIABLES
12010 REM Z4 IS THE VARIABLE TO BE PRINTED
12020 REM Z0$ IS THE VARIABLE LABEL
12030 DEF FNT(Z4,Z0$)
12040 IF Z0(10)>5 THEN FNRETURN -1
12050 IF Z0(8)<0 GOTO 12110
12060 LPRINT TAB((Z0(10)-1)*13);
12070 IF LEN(Z0$)>10 THEN Z0$=LEFT$(Z0$,10)
12080 Z7=INT(5.5-LEN(Z0$)/2)
12090 LPRINT SPC(Z7);Z0$;
12100 GOTO 12210
12110 IF Z0(10)>1 GOTO 12210
12120 IF Z1>1 GOTO 12150
12130 LPRINT:LPRINT
12140 Z0(0)=Z0(0)+2
12150 FOR Z7=14 TO Z0(13)+13
12160 IF Z7>14 THEN LPRINT SPC(2);
12170 LPRINT USING "+#.####^^^^";Z0(Z7);
```

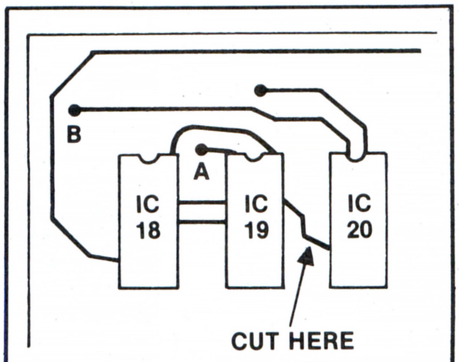
```
13410 LPRINT TAB(6);
13420 FOR Z8=0 TO 5
13430 Z0(15)=Z0(13)+Z0(14)*Z8
13440 LPRINT USING "+#.#^^^^";Z0(15);
13450 IF Z8<5 THEN LPRINT SPC(2);
13460 NEXT Z8
13470 LPRINT
13480 Z0(11)=(Z6-Z5)/50
13490 Z6=1
13500 Z7=1
13510 FOR Z8=0 TO 52
13520 FOR Z9=0 TO 52
13530 Z1$(Z9)=" "
13540 NEXT Z9
13550 IF Z8=0 GOTO 13680
13560 IF Z8=52 GOTO 13680
13570 IF Z7>0 GOTO 13650
13580 FOR Z9=3 TO 51 STEP 2
13590 Z1$(Z9)="-"
13600 NEXT Z9
13610 FOR Z9=1 TO 51 STEP 10
13620 Z1$(Z9)="+"
13630 NEXT Z9
13640 GOTO 13680
13650 FOR Z9=1 TO 51 STEP 10
13660 Z1$(Z9)="¦"
13670 NEXT Z9
13680 IF Z0(300+Z6)<>Z8 GOTO 13730
13690 Z1$(Z0(100+Z6))="*"
13700 IF Z6=Z1 GOTO 13730
13710 Z6=Z6+1
13720 GOTO 13680
13730 IF Z7>0 GOTO 13780
13740 Z0(12)=Z5+Z0(11)*(Z8-1)
13750 LPRINT USING "+#.##^^^^";Z0(12);
13760 Z7=5
13770 GOTO 13790
13780 LPRINT SPC(9);
13790 FOR Z9=0 TO 52
13800 LPRINT Z1$(Z9);
13810 NEXT Z9
13820 LPRINT
13830 Z7=Z7-1
13840 NEXT Z8
13850 Z1=Z1+1
13860 Z0(0)=55
13870 FNEND 0
13880 RETURN
13890 END
```

Speeding Up Your SWTP 6800

By Harry Fair

The process of attempting to decrease execution time can be approached from many different angles. Some timesavers are: streamlining programs, eliminating redundancies, avoiding goto functions, decreasing the arithmetic accuracy or even go to integer arithmetic, such as in TSC's Micro BASIC. You can use a compiler instead of an interpreter for higher level languages; however, you may find the time needed for compiling and saving the compiled code outweighs the advantages on shorter programs. You can also attack the root of the problem and increase the hardware speed.

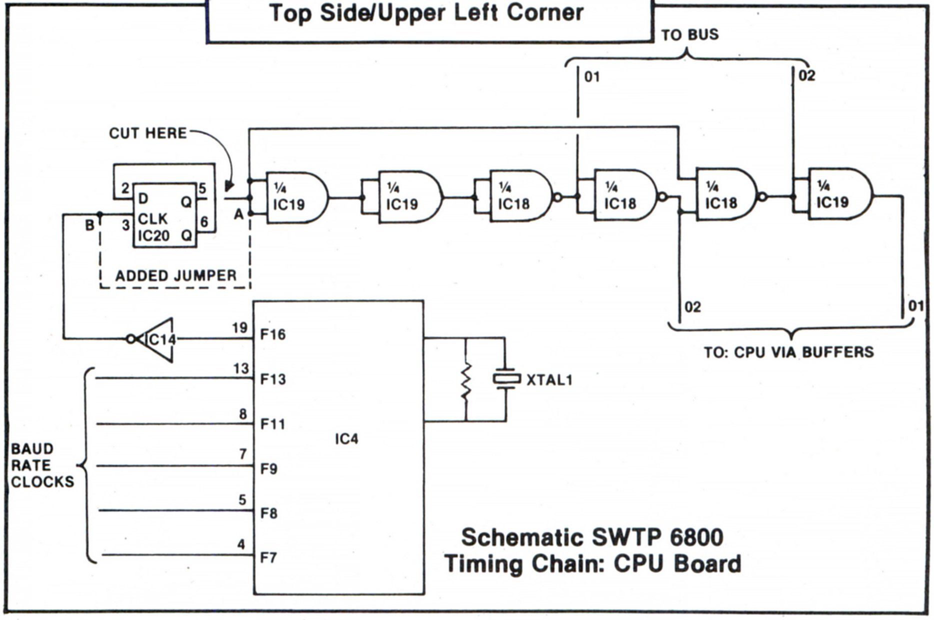
When I first began writing long statistical programs, I became painfully aware of the need for greater speed. Like all good programmers, I began to simplify and eliminate. I reduced the programs down to their very essence. I ran benchmark programs to find the fastest forms of program writing. I even declared all my variables in the start so they would be ordered in the table; but, alas, one program still took over 16 hours to run.



CPU Board Diagram
Top Side/Upper Left Corner

I began to look at other methods. A simpler form of BASIC with only integer arithmetic was out (I need the accuracy and decimals). A compiler seemed logical, but they were expensive and somewhat difficult to use. Finally there was the hardware with all those gates registers and counters.

I chose the latter. It wasn't long before I discovered some interesting things. Most of the 6800 chips sold since early 1977 are capable of running at 2.0 MHz and the Xtal on the CPU board runs at 1.8 MHz, not at .9 MHz. You only need to connect the faster clock to your CPU chip and everything the CPU does will only take half as long.



Schematic SWTP 6800
Timing Chain: CPU Board

The main clock circuits were not difficult either. IC4 (see schematic) is the main clock controlled by Xtal 1. It generates the baud rate frequencies for the PIAs and ACIAs. It also generates the 1.8 MHz clock at pin 19 which goes to a ÷ 2 counter in ½ of IC20. This in turn goes to IC18 and 19 where it is split into 01 and 02 clocks. These last two clocks drive the CPU, the PIAs and ACIAs. By bypassing the ÷ 2 counter in IC20, we can double the two main clocks, 01 and 02.

There are two ways of doing this depending on whether or not you used sockets for your ICs. If you did, pull IC20 out of its socket and bend pin 5 out a little. Reinstall it so pin 5 is *not* in the socket or touching anything. If you don't have IC20 in a socket, cut the trace between IC19 and 20 (see diagram). It's the only one running between the two ICs. Next, insert a jumper between hole A and hole B (see diagram).

Now that the CPU is capable of running twice as fast, examine some of the possibilities of what can be done with it. The most obvious is that programs will be executed in approximately one half the time. This is dependent on the extent of the I/O routines because the interfaces are still running at the same rate.

One of the more intriguing situations that has arisen out of this increase in clock rate to the CPU and interface chips (02) is that you can now record and play tapes through a standard cassette interface (Percom or SWTP) at higher baud rates. Since the CPU is executing MIKBUG routines twice as fast, it can generate and accept data in the MIKBUG format at rates up to 1200 baud. This higher rate works equally well for saving and loading BASIC programs and data.

Before making this modification, I suggest running one of the memory diagnostics such as CDAT-2 and timing how long it takes. After the modification is done and everything has been double checked, run the program again and retime it. The results should prove quite pleasing. If for some reason the modification was done incorrectly or you have one of the early chips that will not support the higher rate, attempting to rerun the program will prove futile.

The only problem that has cropped up so far has been with my BFD-68 disk system. It seems that every once in a while I get a disk error when I'm copying programs from one disk to another. The people at Smoke Signal Broadcasting tell me this is because of the software timing loops in the system. They are aware of the problem and are working on a solution. It happens so infrequently though it does not seem to be of much consequence.

The other thing to be aware of is, if program loops are used to interface with the real world, these loops will have to be lengthened to compensate for the faster execution time. Except for these two things, I have experienced no problems or lost bits in over a thousand hours of use. I have noticed, however, an increase in reliability with my tape interface even at the higher baud rates.☐

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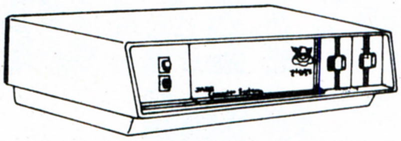

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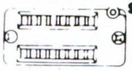

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Single or double density, up to 40 tracks, track to track access time only 5ms.

MPI B52 5 1/4" $450.00
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Shugart SA400 5 1/4" $325.00
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Siemens FDD100-8 8" $495.00
Shugart 801R replacement, Single or double density, runs cooler and quieter.

Siemens FDD200-8 8" $575.00
Double head version of FDD100-8 capable of double density, double sided storage.

Shugart 801R 8 " $875.00
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FLOPPY DISK INTERFACE

JADE FLOPPY DISK (Tarbell board)

Kit	$195.00
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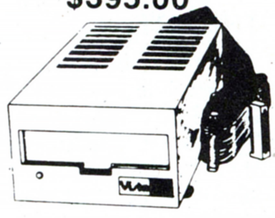
S.D. Computer Products
VERSA-FLOPPY

Kit	$159.95
Assembled & Tested	$239.00

Vista V80 Mini Disk SYSTEM FOR TRS—80

$395.00



Includes disk drive, power supply, regulator board, and compact case. The V-80 offers 23% more storage capacity. Simply take it out of the box, plug in the cable, and it's ready to run. Requires 16K, Level II, expansion interface.

Interface Cable . . $24.95

Vector Plugboards

8800V
Universal/Microcomputer/Processor Plugboard Use With S-100 Bus. Complete With Heat Sink & Hardware.
5.3" x 10" x 1/16"
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Same as 880V Except Plain, Less Power Buses & Heat Sink.
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3662 6.5" x 4.5" $7.65
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3682 9.6" x 4.5" . . $10.97
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Card Extender Has 100 Contacts 50 Per Side ON .125 centers. Attached Connector is Compatible With S-100 Bus Systems
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CIRCLE INQUIRY NO. 77

System of the Month

Pertec Computer's PCC 2000

By Tom Fox, Systems Editor

When the founder of an industry introduces a significantly different product, many people take notice. There's a good possibility that the people who established the mold for an entire generation of equipment might just be onto something once again.

The PCC 2000 comes from the same place (via a few corporate gyrations) that introduced the world to hobbyist computers, which were quickly transformed into low-cost business computers; the same place that invented the ubiquitous S-100 bus; the same place that transformed "8080" into a household word (or part number). Now they offer something new.

The PCC 2000 is very nearly what the large computer industry calls a "turnkey" system: Remove the shipping carton, plug it in, and start solving business problems with your new computer. It's a far cry from the first Altairs, which were do-it-yourself kits to begin with, and offered absolutely no applications programs at all.

"Package" is the best way to describe the PCC 2000, and the word applies in several senses. The hardware itself is housed in an attractively and amazingly rugged enclosure. The computer, CRT terminal, two floppy disk drives and all required electronics are contained in a module that takes up a space only 26 inches square on the desk top. The small size belies what's inside: a full 65,536 bytes of memory and 1,200,000 bytes of storage on the two full-size double-density floppy disk drives.

The processor used is the 8085, an advanced version of the pioneer 8-bit 8080. At 3 MHz, the 8085 is faster and needs fewer supporting electronics (which translates into higher reliability and lower power consumption) than its predecessor. The system features Direct Memory Access and Vectored Interrupt handling, both of which are utilized by the floppy disk subsystem to speed up data transfers. This is particularly important in a system intended for business applications, where moving information to and from the disk usually takes up the bulk of the time spent to do a given job.

The 8-inch floppy disk drives are manufactured by a division of the parent Pertec Computer Corporation, an advantage that can be claimed by almost none of the competition. The stepper-motor technology used for read/write head positioning limits the average access time to 488 milliseconds — somewhat slower than average. (The fastest disk drive in this respect is the more expensive PerSci, which clocks in at 33 milliseconds.)

THE CRT

The CRT display screen is a definite step forward in the art of viewability. Characters are formed by a 7 x 9 dot matrix, with 3-dot descenders, allowing lower-case letters such as "g" to be displayed in their natural position. Additional features of the display are special forms characters (horizontal and vertical lines, etc.), a choice of high or low intensity, reverse video, character underline, and blinking characters. A clever programmer can use these enhancements to create some truly exciting and informative screens. Display size is the near-universal 24 lines of 80 characters each.

The keyboard has 89 separate keys, more than are necessary. They are intended to make the operator's task an easy one. Featured is a ten-key adding machine style keypad with its own RETURN key, and a nice visual grouping of the four "arrow" keys. In conformance with the latest theories on low-fatigue data entry, the keyboard "floats"; that is, it can be moved around a few inches to the most comfortable position.

A NEW BUS

Lift the cover and a surprise awaits. The first to use (by right of invention) the S-100 bus has abandoned it! In its place we see a row of plug-in circuit cards of an entirely different shape, mounted into 100-pin connectors on a horizontally-mounted mother board in the standard fashion. Pertec is not about to tell the precise electrical differences between their new P-100 bus and the by-now-familiar S-100 variety, except that pains have been taken to ensure an electrically "quiet" environment for the computer circuitry. The standard complement of boards occupies only five of the 12 available slots, leaving plenty of room for expansion.

The unit is equipped with a serial interface for a printer (the dot-matrix Centronics or daisy-wheel Qume are recommended), the only essential part of the computer that doesn't fit into the enclosure. An additional serial port is available for those who opt for the multi-user software option.

SOFTWARE

"Packaged" is a term that describes the software as well as it does the mechanical assembly of the computer. First in the catalog are all of the "big five" business programs: General Ledger, Accounts Receivable, Accounts Payable, Payroll and Inventory. These packages are intended to fit over 90% of the small businesses which are the target market of the PCC 2000. That percentage may sound ambitious, but the bulk of the purchasers of this unit will be first-time computer users who probably do not have rigidly established procedures that must be maintained at the (usually considerable) expense of re-programming the computer.

For many small businesses, the advantages of having an in-house dedicated system for data processing can easily justify the inconvenience of changing existing business practices that may very well not be optimized in any case. If a firm absolutely cannot adapt its practices to fit the computer's, the usual alternative is to avoid the "canned" programs and start from scratch — an approach that could easily exceed the purchase price of a computer in this category.

Although this machine is intended to be used more by the non-programming end user, the software tool kit contains much that will be useful to applications programmer types. First on the list is the familiar Microsoft BASIC interpreter, including an extensive array of string-handling operators for those who want to write a word processor. Also supported is formatted printing via the PRINT USING statement, almost indispensable when writing business-oriented programs. Both sequential and random disk files are usable from BASIC programs, although much efficiency is lost by the requirement that data files be exactly 128 bytes (characters) long — no shorter, no longer.

ISAM (Indexed-Sequential Access Method, an advanced technique for searching through random files for specific information) is supported in the form of BASIC subroutines that can be copied into your programs. Linkages to assembly-language routines from BASIC programs are possible, but

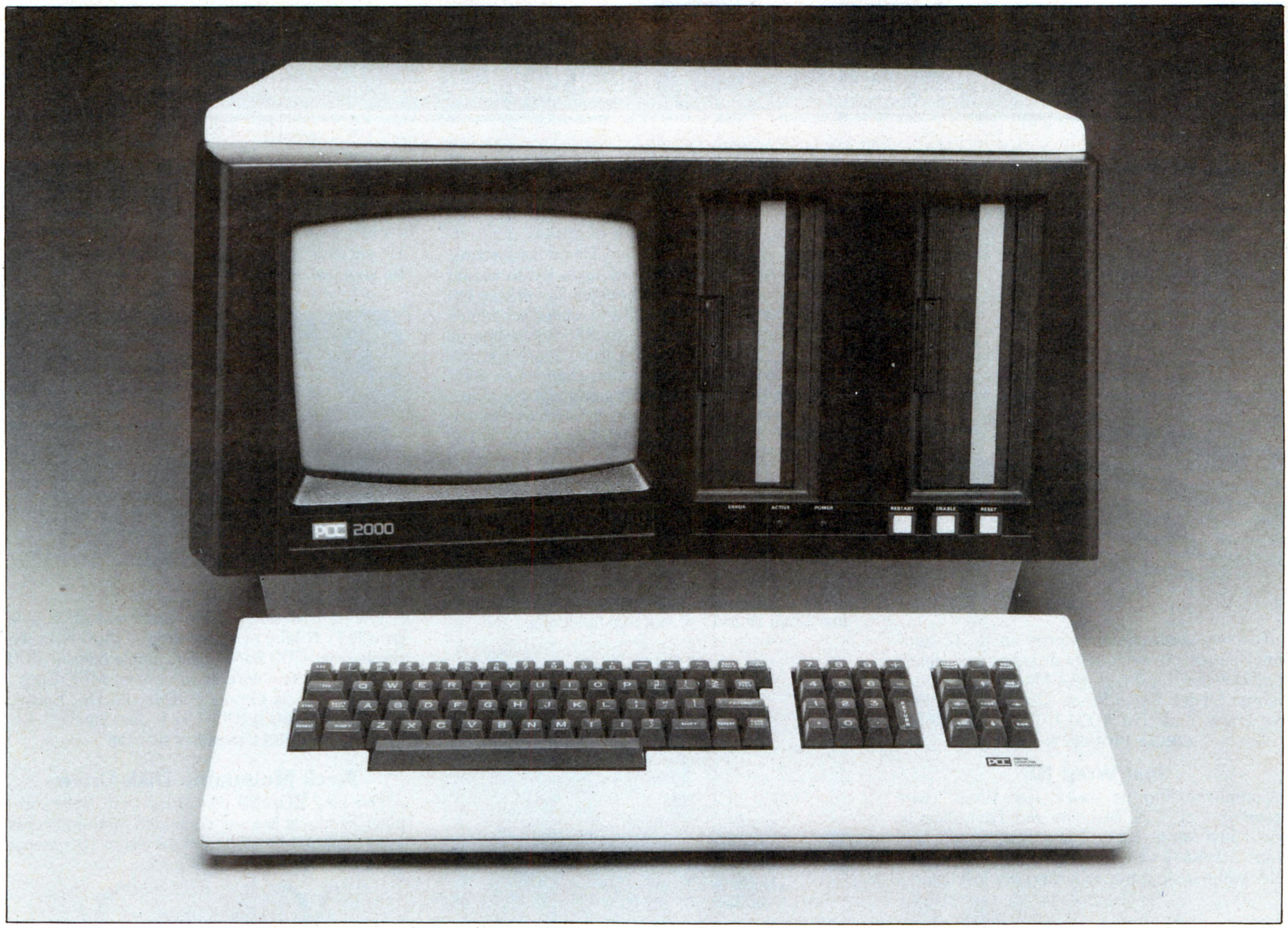


Photo courtesy of Pertec Computer Corporation

this capability seems to have been included for the convenience of the Pertec programmers — as there is no way to write or assemble 8085 code using standard software supplied with the PCC 2000. It is possible, however, to install the popular CP/M operating system on the machine.

The most spectacular bit of software comes not from Pertec itself, but from their Dallas, Texas, dealer. Available from any PCC 2000 outlet, a word processing program called QTYPE is an excellent showpiece for the flashy capabilities of the CRT display and keyboard. QTYPE probably represents the ultimate of what can be accomplished in a word processor within the limitations of the BASIC language, and it's only possible here because of the special capabilities of the display hardware.

DEALER SUPPORT

Many businesses have (wisely) hesitated to purchase a computer solely because the one they could afford was from a manufacturer whose stability was questionable and whose service policies were, to put it mildly, informal. By way of contrast, much of Pertec's strength as a $150 million company is its extensive field service organization: nearly 400 field technicians assigned to over 75 cities in the U.S. and Canada. Although this army is primarily in place to service other Pertec computer-related products, they are in the process of being trained and equipped to handle the PCC 2000 as well.

So what is it that this product tells us of the future of small business computers? The fact that it is different than its predecessors is not, of itself, much of a surprise in this age of daily advancements to the technology. What is new is that a manufacturer has carefully researched the needs of the users, and has done an admirable job of producing a single product that is sure to become a useful tool for a large portion of them. It is significant that Pertec did not see fit to utilize the most technical up-to-the-minute developments — they really aren't needed here.

In terms of performance (processing speed, storage capacity, etc.), the PCC 2000 rates only as Very Good; several of its competitors surpass it in one category or another. The point is that this is a balanced package of computing capability, containing all the pieces that will be needed by the majority of users, offered in a manner that elicits confidence on the part of the purchaser.

Pertec's way of selling the PCC 2000 is through their "own" stores; there are rarely competing brands to confuse the average buyer. The retail division of the Pertec organization is in the midst of a controlled expansion — over 60 dealers have been added over the past two years. There are nearly 100 of them now throughout the United States.

PRICING

Suggested retail price for the PCC 2000 is $9,995, including BASIC and all of the hardware described except the printer. The five major business accounting programs are available at $1,000 each. The system can be expanded by the addition of more RAM memory, additional floppy disk drives, and even a ten-million-byte hard disk drive, also manufactured by one of the Pertec divisions. The latter option raises the price of admission to $19,900, but brings with it a whole new world of storage capability and data processing speed.

An interesting recent option is a multi-terminal operating system they call MTX. This costs $1,000 plus just under $2,000 for each terminal added. The extra terminals match the one built into the PCC 2000 with regard to styling and extended capabilities.

Pertec Computer Corporation, Microsystems Division, is at 20630 Nordhoff Street, Chatsworth, CA 91311. Telephone is (213) 998-1000.☐

NEW PRODUCTS

Electronic Text Editing Typewriter

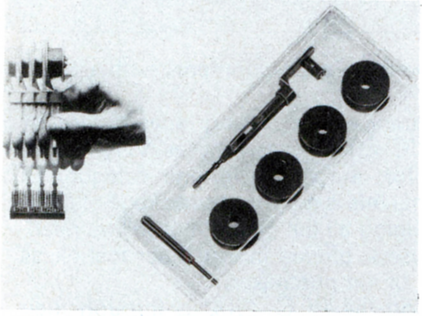
The Adler SE-2000 brings the power of word-processing to the secretary's desk at a cost within the budget of the smallest office. The SE-2000 has a built-in working memory that stores up to two pages of typing.

Its minidiskette system stores up to 32 additional pages on each mini-diskette. For details contact Adler-Royal Business Machines Inc., c/o George Siegel, Philip Stogel Co. Inc., 489 Fifth Ave., New York, NY 10017, (212) 682-7600.

CIRCLE INQUIRY NO. 121

Just Wrap Kit

Complementing its new "Just Wrap" wire wrapping tool, O.K. Machine and Tool offers its new "Just Wrap Kit." The "Just Wrap" tool wraps 30 AWG wire onto standard .025 square posts without stripping or slitting the insulation.



The JWK-6 Kit contains the Just Wrap wrapping tool, the JUW-1 unwrapping tool, and four 50 ft. wire refill cartridges, all packaged in a reusable clear plastic box. Price is $24.95. For details contact O.K. Machine and Tool Corp., 3455 Conner St., Bronx, NY 10475.

CIRCLE INQUIRY NO. 122

Investment Software

Mathematical Analysis specializes in investment software, currently leaning toward the hedging of listed options against common stocks. Four programs are presently available on disk for North Star DOS or on cassette for PolyMorphic systems.

Program OPTION generates all the important profit indices for both opening and closing call option transactions including the effects of commissions, dividends, and margin interest.

Program OPGRAPH presents a table or graph of profit versus stock price for all combinations of stock bought or owned, calls bought or sold, and puts bought or sold.

Program NEWPREM accepts as brief or detailed a database as desired and returns the future price of an option as a function of stock price and time.

Program PORTVAL tabulates the current portfolio including options along with cost, current value, capital gains, subtotals and totals.

For program descriptions and sample outputs contact Mathematical Analysis, 10360 E. Flintlock Tr., Tucson, AZ 85715.

CIRCLE INQUIRY NO. 123

1979 TRS-80 Income Tax Programs

For accountants and others involved in the preparation of income tax forms, Contract Services Associates now has a full line of professional software for TRS-80 32K disk and line printer systems.

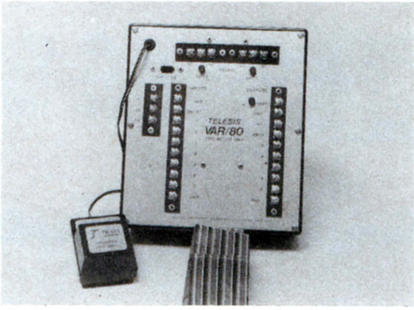
The system will do income taxes ten to twenty times as fast as other methods while virtually eliminating error. Form 1040 and related schedules are displayed on the video monitor while figures and other data are entered, computations are performed automatically, and then changes or additions can be made before printing out the form.

For details contact Contract Services Associates, 706 S. Euclid, Anaheim, CA 92802, (714) 635-4055.

CIRCLE INQUIRY NO. 124

Telesis VAR/80 I/O Interface

The Telesis VAR/80 I/O interface was designed specifically for the Radio Shack TRS-80 (Level II BASIC) owner. It provides the user with a simple means of interfacing the TRS-80 with the "Real World" of external functions.



The VAR/80 comes fully assembled, tested and guaranteed. It can be used with or without the TRS-80 expansion interface. The unit itself has provisions for 8 inputs and 8 outputs.

Price is $109.95. For details contact Telesis Laboratory, P.O. Box 1843, Chilicothe, OH 45601, (614) 773-1414/5157, Jim Eley.

CIRCLE INQUIRY NO. 125

Full-Size Floppy for TRS-80

Maxi-Disk by Parasitic Engineering is a Shugart 800-based floppy fully compatible with existing TRS-80 mini drives and can be mixed and matched with the smaller drives. The system plugs right into the TRS-80 expansion interface.

All the user has to do is remove the disk controller chip from the expansion interface and replace it with a specially designed circuit board. In that circuit board is a socket where the controller chip is re-inserted.

Price is $995. For details contact Parasitic Engineering, Box 6314, Albany, CA 94706, (415) 527-6134.

CIRCLE INQUIRY NO. 126

Double-Sided 5-Inch Floppy

The DataTrak™ 5 is a new 5¼-inch double-sided double-density floppy disk drive that has an unformatted data storage capacity of 437.5 kilobytes and a formatted capacity of 286.7K bytes. The recording density of the DataTrak 5 drive is 5456 bpi, and its transfer rate is 250K bits per second.

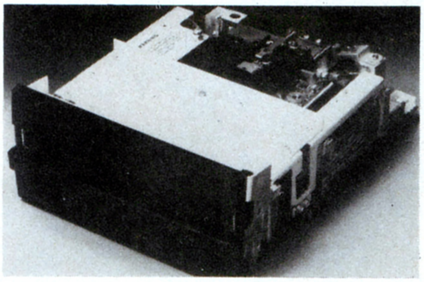
Among the standard features of the DataTrak 5 are an LED activity indicator and a "door closure lockout" that provides media physical damage protection by ensuring that the drive door cannot be closed if the disk is not properly inserted. Operation is either +12 Vdc or +5 Vdc.

Single quantity price is $465. For details contact Qume Corp., P.O. Box 50039, San Jose, CA 95150, (408) 942-4000, Gail James, Dir. Mktg., Memory Products.

CIRCLE INQUIRY NO. 127

Disk Drives with Brushless Motors

A full line of double-sided, double-density flexible disk drives with either DC brushless or AC motors provide a 10,000 hour MTBF, a head life exceeding 4 x 10^7 wear revolutions, and can be supplied in eight models.



The double-sided 700 Series offers double density (1.6 MB) or single density (800 KB); the single-sided 500 Series offers single density (400 KB). For more information contact MFE Corp., Digital Products Group, Keewaydin Dr., Salem, NH 03079, (603) 893-1921, Jim Saret.

CIRCLE INQUIRY NO. 128

Rack Mountable Disk Drive

The new BD-100 disk drive from Ball Computer Products is a self-contained random access mass storage unit storing in excess of 100 megabytes on a removable disk pack.

Five read/write surfaces, each carrying 1024 tracks, store a total of 103.22 x 10^6 bytes. Each track carries 20,160 bytes or 161,280 bits (including header and gaps). Track density is 465 tracks per inch. Recording method is MFM, bit serial.

For more information contact Ball Computer Products, 860 W. Arques Ave., Sunnyvale, CA 94086, (408) 733-6700.

CIRCLE INQUIRY NO. 129

Disk Subsystems

A new family of fixed head-per-track disk subsystems, fully software transparent to DEC's RJS04 and RWS04 subsystems has been introduced by Emulex, a manufacturer of controllers and subsystems for mini and microcomputer systems. Complete subsystems are available for all models of the PDP-11 (including 11/70) and LSI-11 computers.

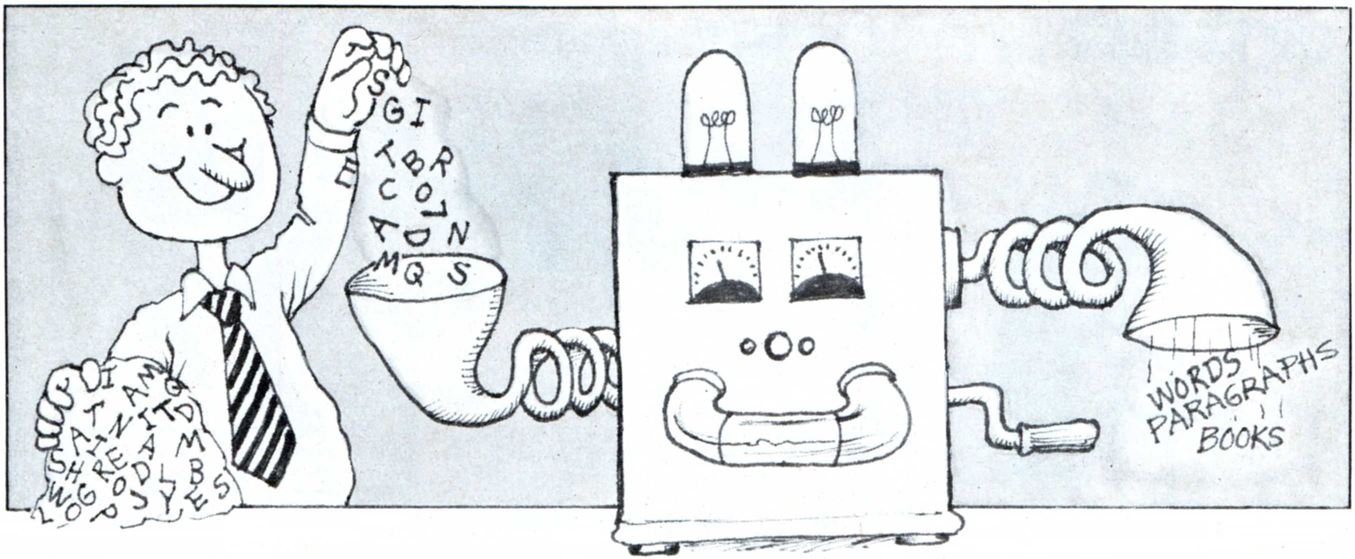
The three basic subsystems offered are designated the SS01/F, SS11/F, and SS70/F for the LSI, PDP-11 and PDP-11/70 computers, respectively. Each is designed to exactly emulate the functional characteristics of the RJS04 or RWS04 fixed head-per-track disk subsystems made by Digital Equipment Corporation.

For more information contact Mr. Fred B. Cox, President, Emulex Corp., 17785 D Skypark Circle, Irvine, CA 92714, (714) 557-7580.

CIRCLE INQUIRY NO. 132

ADVERTISEMENT

Word Processing software for the AM-100



AT LAST! After months of careful research, and many rounds of user testing and evaluation, we have developed a **POWERFUL, VERSATILE,** yet **EASY TO USE** word processing package for the Alpha Micro AM-100. Our software vastly increases the productivity of typists, while making their work more pleasant.

Users with no computer or word processing experience can easily master the **Khalsa Word Processing System** with only a half-day of training and a few days of practice. "Help" is always available at the touch of a key. Typists can enter text rapidly, because they don't have to worry about making errors or entering carriage returns — words which won't fit on one line are automatically shifted down to the beginning of the next, and errors are simple to spot and fix. Entire blocks of text can be moved about easily. Automatic form letters are handled effortlessly.

At print time, there are no surprises as there are with many other word processing systems — a document can be displayed on a terminal essentially as it will appear when printed. When completely correct, the finished document can be sent to the printer. While it is being printed, work can continue on another document.

SELECTED FEATURES:

Automatic carriage return (word wraparound) • Automatic paragraph indentation • Automatic centering • High-speed search/replace (single or multiple) • Unlimited text movement • Single sheet or continuous form printing • Scrolling — both forward and backward • Cursor control — left, right, up, down • Move to next word, tab, sentence, page • Move to beginning or end of screen, page, or text • Delete character, word, line or block • Automatic table of contents • Automatic chapter and sub-chapter numbering • Automatic page numbering — top or bottom of page, with or without header lines • Chapter-relative page numbering • Automatic file backups • Automatic or manually directed file insertions • Selected item insertion from external files ("non-linear merging") • Automatic letter writing, keyed to mailing lists • Boiler plate text insertion • Soft hyphenation (adds hyphen only when necessary) • Forced spacing (forces related words to appear together only on the same line) • Boldface printing • Underscoring • Many print format controls including: page length and width; line spacing; variable character spacing (pitch); left, right, top and bottom margins; right justification; page number format; default print controls; and the ability to store standard document formats for instant use with any new text.

We have the **ONLY** software which supports variable spacing for the DIABLO and NEC printers on the Alpha Micro right now. No one else can make this claim! And because our software runs under the 'AMOS' multi-tasking operating system, you'll have true multi-station word processing capability, with account/password security. Several operators can work on different parts of the same document at the same time.

WHAT ABOUT THE FUTURE? Because it's on the Alpha Micro, you have true **DEVICE INDEPENDENCE** and incredible **UPWARD EXPANDABILITY**. The system uses inexpensive, conventional CRT terminals — no custom hardware. Additional stations can be added for essentially the cost of the added terminals. Additional features, soon to come: superscripting, subscripting, footnoting, indexing, and much, much more!

WHAT DOES IT COST? Only $450.00, when purchased as part of a complete system. Future enhancements are available for only a nominal handling charge. Every day you wait costs you money... so call or write for complete details **TODAY!** Better yet, see your local dealer for a demo... you'll be impressed.

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CIRCLE INQUIRY NO. 78

DEFINITELY DIFFERENT . . .

FROM HAYDEN

New! **Z-80 AND 8080 ASSEMBLY LANGUAGE PROGRAMMING** (Spracklen) An extensive introductory look at assembly language programming for the 8080 and Z-80 processors. Programming techniques are presented along with the instructions. Numerous diagrams and examples are provided, plus exercises with answers. *#5167-0, $7.95*

New! **DESIGNING MICROCOMPUTER SYSTEMS** (Pooch & Chattergy) Provides both hobbyists and electronics engineers with the information necessary to build microcomputer systems. Also discusses the hardware aspects of microcomputer systems, including microprocessor architecture, input and output ports, interrupt systems, programmable clocks, memory units, etc. *#5679-6, $8.95*

New! **SIXTY CHALLENGING PROBLEMS WITH BASIC SOLUTONS** (Spencer) Will sharpen your programming skills through games, puzzles, science problems, business problems and mathematical recreations. *#5180-8, $6.95*

New! **PASCAL WITH STYLE: Programming Proverbs** (Ledgard & Nagin) A style guide for writing more accurate, error-free programs. Includes samples of PASCAL programs and a special chapter showing how to use the top-down approach. *#5124-7, $6.95*

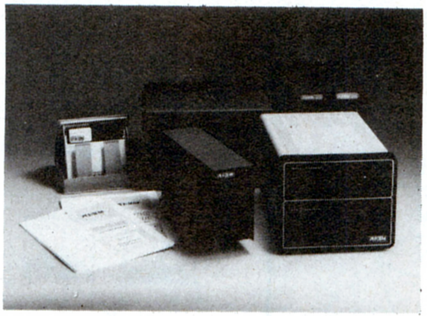
Available at your local computer store.

Hayden Book Company, Inc.
50 Essex Street, Rochelle Park, NJ 07662

CIRCLE INQUIRY NO. 25

Percom Expands Disk Drive Line

Percom Data Company has expanded its line of LFD mini-disk systems for 6800/6809 computers to include 77-track single- and double-density storage systems. The LFD product line now includes LFD-800™ and LFD-1000™.



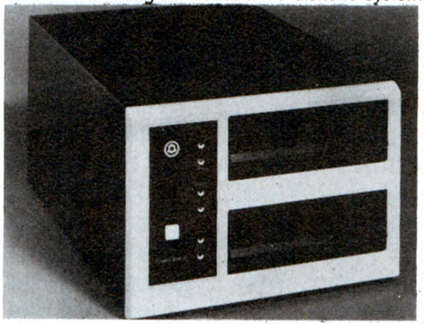
The LFD-800 stores 200K bytes in single-density format on 77 tracks. The LFD-1000 is a dual-drive system that stores 400K bytes per disk in double-density format on 77-track disks.

For details contact Percom Data Co., 211 N. Kirby, Garland, TX 75042, (214) 272-3421.

CIRCLE INQUIRY NO. 130

Diskette Storage from AT&T

AT&T has a diskette storage unit designed to increase the transmission speed and improve the economy of data communications systems. The Comm-Store II Communications Storage Unit consists of a single or dual drive diskette system which can be used to store messages received on-line or to prepare messages off-line for transmission. For details contact AT&T, 195 Broadway, New York, NY 10007, (212) 393-6413, Marge D'Amico.



CIRCLE INQUIRY NO. 131

Double-Sided Floppy Disk Drive

BASF Systems has begun U.S. production of its Model 6108 double-sided 5.25" Floppy Disk Drive. The 6108 requires 33% less space than the Shugart SA-400.

Ideal for calculator, desk-top computer, point-of-sale terminal and word processing applications, it serves as an alternative to paper tape, magnetic tape cassettes and magnetic card devices.

The 6108 is priced at $565 in single quantities. OEM quantities are available at discount prices. For more information contact BASF Systems, Crosby Dr., Bedford, MA 01730.

CIRCLE INQUIRY NO. 133

New Leasametric Catalog

A new 6-page rental catalog and price list covering Hewlett-Packard data terminals and desktop computers is now available, at no cost, from Leasametric.

The catalog also describes Leasametric's long-term rental, rent-with option, and lease financing programs, as well as basic Rental Terms and Conditions. The equipment listed consists of the Hewlett-Packard 2621A, 2621P, 2631A, 2631G, 2635A, 2645A, 2647A, 2648A, 9825A, 9825S, 9835A, 9845S and the 13290B.

For a copy or more information contact Leasametric, 1164 Triton Dr., Foster City, CA 94404, (415) 574-4441, Murray Berger, Mgr. Corporate Communications.

CIRCLE INQUIRY NO. 138

Security Systems Brochure

The capabilities of Cardkey security access control systems — ranging from simple door control to complex central control access, security monitoring, data gathering and reporting operations — are described in a new 12-page brochure by Cardkey Systems.

Cardkey
The Name Means Access Control

The illustrated, full-color access control systems brochure highlights the use of Cardkey access control systems for time and attendance reporting, elevator control, turnstyles and parking, alarm monitoring and related security functions and more. For a copy, contact Cardkey Systems, 20660 Bahama St., Chatsworth, CA 91311.

CIRCLE INQUIRY NO. 134

COSMAC Booklet from RCA

A 12-page booklet *COSMAC Microboard Computer Systems,* CMB-250, describing a new line of milliwatt-operated easy-to-use computer, memory, I/O and control units is now available from RCA Solid State.

RCA
COSMAC Microboard Computer Systems

Providing ready-to-use hardware for custom applications of microprocessor-based computer equipment, the Microboard units described include three "computer-on-a-board" systems, four memories, five I/O modules, and two multi-board prototyping systems.

For a copy contact RCA Solid State Div., Box 3200, Somerville, NJ 08876.

CIRCLE INQUIRY NO. 135

Guide to Electronic Products

Analog Devices offers their *1979 Short Form Guide to Electronic Products for Precision Measurement and Control.* The 40-page soft-cover guide contains easy-to-look up specifications and prices for over 500 standard data conversion products, signal conditioning products, temperature instrumentation, digital panel instruments, power supplies and more. All key specifications are listed for all types of products. For a free copy contact Analog Devices, Route 1, Industrial Park, Norwood, MA 02062.

1979 SHORT FORM GUIDE
Electronic Products for Precision Measurement & Control
ANALOG DEVICES

CIRCLE INQUIRY NO. 136

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CIRCLE INQUIRY NO. 92

Mini/Micro79

The Far West Classic in the heart of California Computer Country

Here's a progress report on Mini/Micro79, the far west computer event of the year in the heart of the super-active Southern California computer market-place.

Mini/Micro returns to beautiful Anaheim Convention Center, September 25-27 with a terrific conference program and a timely, sparkling expo of brand-new products from chip-level to full systems, and including a new test instrumentation section.

In the column at the right are the names of 80 fine companies who form the preliminary list of exhibitors. And just below are the titles of 24 solid sessions, as selected by Program Co-chairmen Neil Kelley (Infosystems) and Bob Brown (Hewlett-Packard) and the 1979 Mini/Micro program committee.

The Conference program at a glance

Tuesday

AM
- Pascal on Minis and Micros
- Desktop Computer Applications
- Distributed Processing and Terminal Systems
- Computer Privacy and The Law

PM
- Future Developments in Small Computer Software
- Computer Graphics
- 32-Bit Machines and Other Megaminis
- Maintenance and Fail-Safe Operation

Wednesday

AM
- Military Microcomputers
- Data Base Management Systems for Minis
- Technology Impact on Data Communications
- Mass Memory Storage

PM
- Industrial Microcomputer Applications
- Success with Single-User Computers
- Telecommunications from the Terminal User's Viewpoint
- Printers and Other OEM Peripherals

Thursday

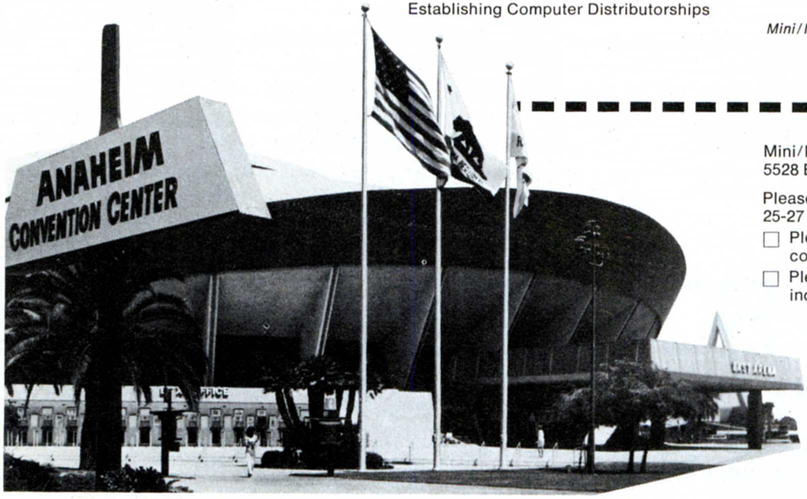
AM
- How Many Bits Do You Need?
- IBM-Software Compatible Minis
- Memories: MOS, Bubbles, and CCDs
- Small Business Computers

PM
- Micro Testing at Chip and Board
- "IBM Watching": Products and Marketing in the Eighties
- Development Software for MPU's
- Establishing Computer Distributorships

An Early-Bird List of Mini/Micro Exhibitors

Able Computer Technology
Addmaster
Aero Mayflower Transit
AFIPS
Anadex Inc.
Avanti
Ball Computer Products
Ball EDD
Benwill Publishing Corp.
Cahners Publishing Co.
Calex Manufacturing
California Computer Products
CAP-CPP Inc.
Centronics
Century Data Systems
Cipher Data Products
Columbia Data
Computer Automation
Computer Business News
Computer Interface Technology
Control Data Corp.
CW Communications Inc.
Data Electronics Inc.
Datum Inc.
Digital Equipment Corp.
Documentation Systems Inc.
Educational Data Systems
EECO
Epic Data
General Automation
Hamilton/Avnet Electronics
Haveg Industries Inc.
Hewlett-Packard, Desktop Computer Division
Hewlett-Packard, Systems Division
Interdyne Company
Intermec
Intel Corporation
International Data Corp.
International Data Sciences
IPI
Jade Computer Company
Kierulff Electronics Inc.
Lear Siegler Inc.
MDB Systems
Megatek Corporation
Memorex
Micom Systems
Microfocus
Mitsubishi Electric
Monolithic Systems Corp.
Moxon Electronics
NCR Corporation
Newport Data Systems
Paradyne Corporation
Printronix Inc.
Racal-Vadic
Randal Data Systems
Ramtek Corporation
Remex
Scientific Micro Systems
Sola Electric
Sord Computer Systems
Space Byte Computer Corp.
Summagraphics
Systems Furniture Company
Tektronix
Tele-Dynamics
Teletype Corporation
Telpar Inc.
Texas Instruments
3M Company
Triple I, Inc.
Western Digital
Western Peripherals
Wilson Laboratories
Wyle/Liberty Electronics

Mini/Micro Computer Conference and Exposition, Robert Rankin, Managing Director



Mini/Micro Computer Conference and Exposition
5528 E. La Palma Avenue, Suite 1A, Anaheim, CA (714) 528-2400

Please send me complete information on Mini/Micro79, to be held Sept 25-27 in Anaheim Convention Center, as follows:

☐ Please send me a detailed Preview Program (available August 1) with complete program, registration, and hotel information.

☐ Please send me complete information on exhibiting in Mini/Micro79, including floorplan and exhibitor services furnished.

Name ____________________
Title ____________________
Company ____________________
Address ____________________
City, State, Zip ____________________

The Wordsmith™ Text Editor

Wordsmith defines a new type of text editing and document processing environment for 8080 or Z-80 based microcomputers. In contrast to the line-oriented editors of the past, Wordsmith is page-oriented which means that documents are stored on disk as a collection of pages that can be individually manipulated, cut and pasted, and rearranged in much the same way as a hardcopy document.

Wordsmith is written in reentrant 8080 code and is designed to run on memory mapped video boards. It is CP/M and North Star DOS compatible, and will support most printers. Wordsmith is available on 5¼" or 8" diskette. Cost is $200. For more information contact Micro Diversions, Inc., 8455-D Tyco Rd., Vienna, VA 22180, (703) 827-0888.

CIRCLE INQUIRY NO. 152

Fractional HP D-C Motors

Designed for a wide range of industrial applications, Series 2232 top-precision, permanent magnet d-c motor is now available from Micro-Mo Electronics, Inc.

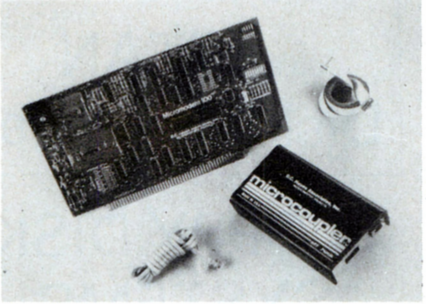
Especially adaptable to tape handling systems, the fractional HP motors are .866 inches in diameter with a length of 1.26 inches. Rated output is from 2.9 to 3.7 watts and standard nominal operating voltages are 3, 12, and 24 volts.

For more information contact Micro-Mo Electronics, Inc., 3691 Lee Rd., Cleveland, OH 44120, (216) 921-1131.

CIRCLE INQUIRY NO. 153

Modem for S-100

The Micromodem 100™ is a complete data communications system for S-100 microcomputers. The new system combines on a single board functions which formerly required a modem, an automatic calling unit and serial and parallel interfaces. The board is a sophisticated computer-to-computer or terminal-to-computer modem for small computer systems.



For details contact D.C. Hayes Associates, Inc., 16 Perimeter Park Dr., P.O. Box 9884, Atlanta, GA 30319, (404) 455-7663.

CIRCLE INQUIRY NO. 155

Apple II Speech Synthesizer

The Model CT-IA is a new speech synthesizer from Computalker adapted specifically for the Apple II microcomputer.

The Model CT-IA is a completely self-contained system. It comes complete with its own 14"w x 4"h x 7"d chassis and 110 VAC power supply.

Internally, the single interface circuit board contains an onboard 2 watt audio amplifier, an S-100 adapter for the CT-1 speech synthesizer board, and an Apple II compatible edge connector.

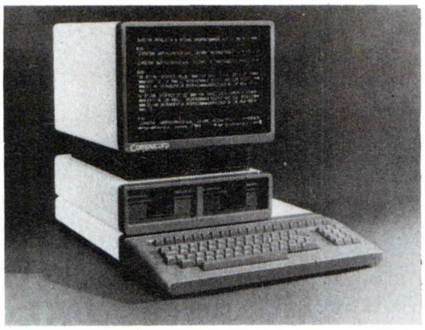
The CT-IA can be operated in two modes: Direct Parameter Control, and Phonetic, and is supported by a growing library of software.

Price is $595 including the self-contained unit, interconnect cable, Apple controller card, user manual and software. A special adapter unit for the Apple is available for owners of the CT-1 speech synthesizer. For more information contact Computalker Consultants, 1730 21st St., Suite A, Santa Monica, CA 90404, (213) 828-6546.

CIRCLE INQUIRY NO. 156

Desk-Top Computer

The Compucorp 655 is a low cost professional quality computer that is "office-engineered" to fit into any available workspace.



The Compucorp 655 is comprised of three basic modules: a large screen CRT, an electronics package, and a separate keyboard. All are attractively styled to fit into any modern office decor.

Available peripherals include dot-matrix printers and an office-engineered hard disk.

Although numerous turn-key packages are already available for the 655, the computer is also easily programmable in an extended BASIC.

For details contact Compucorp, 1901 S. Bundy Dr., Los Angeles, CA 90025, (213) 820-2503.

CIRCLE INQUIRY NO. 167

5MHz CPU Card

A single-board microcomputer that uses Intel's new 8085A-2 microprocessor to permit operation at 5 MHz is available from Artec Electronics.

The S-100 CPU card is suitable for industrial and process control applications, business pro-

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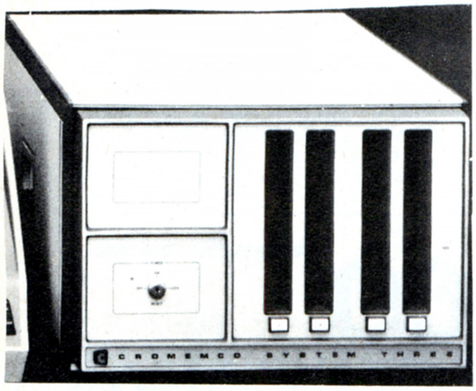

CROMEMCO
SYSTEM 3

List $5990 OUR PRICE **$4990**

Features 4 MHz CPU, 32K of RAM, dual PerSci floppy disk drives (and provision for installing two additional drives), RS232C Interface, Printer Interface — assembled and tested, ready to use.

With 64K of RAM, List $6585	**$5485**

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Now Delivering North Star Double-Density Horizon with 32K RAM Board!

Horizon I, Kit, List $1849	$1559
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Horizon II, Kit, List $2249	$1909
Assem. & Tested, List 2549	$2159

16K Double-Density models still available at super low prices. . .

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Assem. & Tested, List $1899	$1599
Horizon II, Kit, List $1999	$1699
Assem. & Tested	$1939

Famous North Star Double-Density Mini Disk Floppy Disk Interface

Kit, List $699	OUR PRICE $589
Assm. & Tested, List $799	$674

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Horizon 2 w/32K-Q, List $2999	**$2539**

CROMEMCO BOARDS

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Assem. & Tested, List $245	$210
TU-ART Digital Interface, Kit ($195)	$165
Assem. & Tested, List $295	$250
Disk Controller Card, Kit, List $395	$335
Assm. & Tested, List $495	$399

Cromemco Z-2 and Z-2D Kits have been discontinued by the factory — Check with us for price and delivery.

Z-2 Computer System for rack mounting, Z-80 processor, P.S., Assem. & Tested, incl. fan, edge connectors	OUR PRICE $845
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New Super 64K Dynamic Board from Measurement Control Systems, full one-year warranty, fully socketed, available partially populated, A&T:	
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Populated with 48K, List $695	$589
Populated with 32K, List $595	$509
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Dynabyte 16K Static, 4 MHz	
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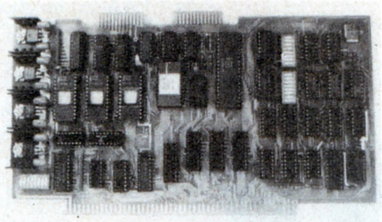


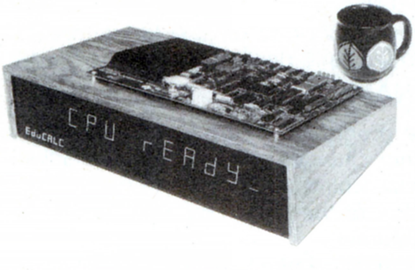
Some features include permanent storage of programs, files and other relevant data in 3K bits of Intel 2708 PROM; 1K of RAM memory for use as a scratch pad. Vectored interrupts, which are crucial to industrial control applications.

Single unit price is $850. For details contact Artec Electronics, 605 Old County Rd., San Carlos, CA 94070, (415) 592-2740.

CIRCLE INQUIRY NO. 158

Teacher's Microcomputer

Every student in a large lecture hall can read the 10 giant characters of the neon slave display on the EduCALC 189 GD. It shows the readout of its built-in Texas Instruments' University Module, a new 16-bit stand-alone board designed specifically for instruction.



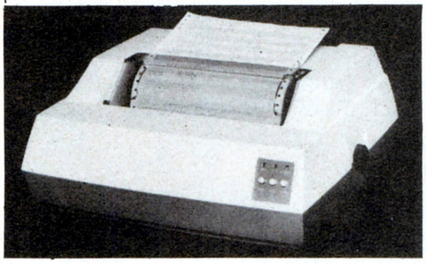
EduCALC comes complete with the 570-page textbook, "Introduction to Microprocessors," suitable for a three credit-hour university course.

Price is $1074. For details contact Educational Calculator Devices, Inc., Box 974, Dept. 43B, Laguna Beach, CA 92652, (714) 497-3600.

CIRCLE INQUIRY NO. 159

Super Brain

The Super Brain Model LP-80 is a bi-directional, dot matrix impact printer with a print head designed for 100% duty operation, assuring a print life that exceeds 100 million characters.



The precision sprocket feed mechanism permits printing forms from 4½" to 9½" wide. A 96-ASCII character set prints in upper and lower case and produces double-width fonts in bold face.

For more information contact Super Brain, Inc., P.O. Box 403, Los Angeles, CA 90073, (213) 477-5992.

CIRCLE INQUIRY NO. 160

C Compiler

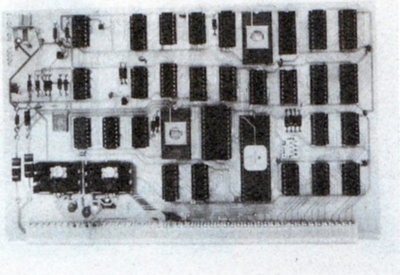
A full C compiler for the Intel 8080 microcomputer is now available from Whitesmiths, Ltd. Accompanying the compiler is a complete set of runtime support routines, the Whitesmiths Portable C Library, an interface library for operation of C under either CP/M or ISIS-II, and a translator for the narrative assembly language A-Natural.

Price is $700 per binary CPU license. For more information contact Whitesmiths, Ltd., 127 East 59th St., New York, NY 10022.

CIRCLE INQUIRY NO. 163

Smoke Signal Video Board

The VDB-1 Smoke Writer is an SS-50 bus video display board featuring the MC6845 CRT controller chip to provide total control over display formats.



The new board controls an 80 x 24 display with 32 graphic characters and has upper and lower case characters with lower case descenders. 128 character graphics are optional. Its programmable character set, a total of 128 characters is in a 2K EPROM.

Price is $349. For details contact Smoke Signal Broadcasting, 31336 Via Colinas, Westlake Village, CA 91361, (213) 889-9340.

CIRCLE INQUIRY NO. 161

Word Processing Software

POWER TEXT™ is a sophisticated document entry, editing and printing system designed for both general and professional office users. In addition to the usual word processing features, POWER TEXT offers easy-to-use commands, global search and replace capability, automatic margin justification, automatic page numbering, both left and right indention, superscripting and subscripting, linking of long documents from diskette to diskette, floating spaces to allow for insertion of diagrams, the ability to handle either single sheet stationery or continuous forms, and complete self instruction documentation.

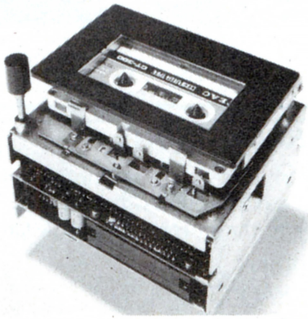
POWER TEXT is written in a high level assembly language and executes within the CP/M operating system or equivalent.

For more information contact Retail Sciences, Inc., Peachtree Software Div., 3384 Peachtree Rd., N.W., Suite 254, Atlanta, GA 30326.

CIRCLE INQUIRY NO. 164

Digital Cassette Tape Drive

The TEAC MT-2 Digital Cassette drives are small in size and low in cost. They offer fast data transfer rates and come in 4 versions: either single or dual gap head, and with or without the interface controller.



The formatted configurations are ANSI-ECMA compatible, and provide most of the interfacing to the 8080, Z80, 6800 and other 8-bit parallel chips. The MT-2 will Read/Write 800 cpi at 15 ips, and searches at 45 ips.

Price is under $300 in 100s. For more information contact Triple I, Inc., 4605 N. Stiles, Oklahoma City, OK 73154.

CIRCLE INQUIRY NO. 162

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CIRCLE INQUIRY NO. 65

CBASIC:

INTRODUCTION

BASIC was the first high-level language to be developed for microcomputers. It is an easy language to learn because many of the commands look like English:

```
PRINT A
READ C
GO TO 5
STOP
```

And there are numerous built-in commands such as square root, sine, cosine, logarithm, etc. Even today with competing languages such as FORTRAN, COBOL, Pascal, APL, and ALGOL, BASIC is still very popular.

Actually, the name BASIC is used to refer to many different types of programs. The smallest ones have a minimum of features and are designed to run in less than 4K bytes of memory. The larger, extended BASICs exceed 20K bytes and contain almost all the features one can think of.

One advantage of BASIC is the ease with which it can manipulate strings (of alphabetic and numeric data). Business records, for example, contain both numeric and string data. The numeric data includes such things as gross receipts, sales, etc. Mathematical operations such as addition and subtraction are performed on this type of data.

On the other hand, names, addresses and telephone numbers are organized into strings of alphabetic and numeric characters. The operations of interest here include the sorting of names in alphabetical order and the finding of a particular name and address.

The typical BASIC processor is an interpreter that resides in memory along with the user's BASIC source program. During execution, the interpreter can be stopped, the current values of the variables can be printed out, then the process can be continued. This feature makes debugging of programs relatively easy.

A FORTRAN processor is usually designed differently. The user's source programs are first converted into relocatable files with a relatively large FORTRAN compiler, then a much smaller FORTRAN loader is used to link the compiled modules at runtime. FORTRAN programs generally run much faster than BASIC programs. But string handling and debugging are much more difficult in FORTRAN than in BASIC.

A COMPILED BASIC

CBASIC and its predecessor BASICE are different from the typical BASIC processor. They consist of two separate modules: a compiler and a run-time interpreter. In addition, a system editor is also required.

An editor, such as the CP/M ED or Microsoft's EDIT-80, is first used to generate a disk file containing the source program. The CBASIC compiler is then invoked to generate an intermediate disk file. For example, the command:

```
B>A:CBAS2 LINFIT
```

will direct the CBASIC compiler on drive A to produce an intermediate file LINFIT.INT on drive B using the source program LINFIT.BAS on drive B. The final step is the command:

```
B>A:CRUN2 LINFIT
```

This causes the runtime monitor on drive A to interpret the intermediate file on drive B and generate the desired result.

LONG VARIABLE NAMES

Most BASIC source programs will be found to run with CBASIC after only minor changes. There are several advantages to be gained by switching to CBASIC from the usual interpretive BASIC. One of the most important features is the ability to use long names.

BASIC names are usually limited to two characters, of which the first must be a letter. Some BASICs require that the second character be a number rather than a letter. Others allow names to be up to five characters long, but only the first two are significant. In this case the variables WE and WEEK are considered to be the same.

CBASIC accepts names up to 31 characters long. This means that in a curve-fitting program there may be variables called:

```
SUM.X
SUM.X.SQUARED
SUM.Y
SUM.X.Y
```

where the decimal point is a unique part of the name. For business applications, such descriptive names as:

```
CURRENT.PAYROLL
INVENTORY.1979 and
FEDERAL.TAX.1978
```

may be used. This makes it easy to write self-documented source programs. Also, reserved words may be embedded in variable names. The usual BASIC interpreter will not accept the name STORE since the reserved word OR is part of the name.

Unfortunately, this freedom requires that blanks be inserted after reserved words so that they can be distinguished from user-defined variables. But then this is simply good programming practice. For example, in CBASIC, the expression:

```
FORI=MTON
```

has a different meaning from

```
FOR I=M TO N
```

The two statements would be interpreted the same by the usual BASIC. However, CBASIC interprets the former as a command to copy the value associated with the variable MTON into the variable FORI. The latter command is interpreted as the first statement of a loop. The use of long names imposes no penalty either in execution time or memory

A Business-Oriented Language for CP/M

By Alan R. Miller, Software Editor

space, since the user's source program is first compiled into an intermediate program.

FEWER LINE NUMBERS

Most BASICs require a line number at the beginning of each line of source code. With CBASIC, line numbers are only needed as labels for program transfer:

```
GOTO 37
IF A = B THEN 268
```

Other lines do not require line numbers. In fact, the compiler will flag (as a non-fatal error) line numbers that are not referenced. This allows the user to systematically remove unneeded line numbers (which might be left over from a different version of BASIC). The resulting source program is easier to understand, and the source code looks much like FORTRAN in this case.

Line numbers need not appear in increasing order (or any order) since they are not used for line sequencing. Decimal numbers, including the E notation, may be used as labels.

MULTIPLE-LINE STATEMENTS

CBASIC allows the user to place several statements on the same line if they are separated by a colon. This feature, which is found in many BASICs, can significantly simplify the programming for conditional branching:

```
IF MONTH = JAN THEN N=4 : GOTO 38
```

A companion feature is not so common. CBASIC allows a single statement to be spread over more than one line by placing a backslash at the end of each line to be continued:

```
IF CURRENT.DAY = 15 \
   THEN FIRST = FIRST + 1 \
   ELSE SECOND = SECOND + 1
```

This technique can also be used with comment lines:

```
REM \
   SORT X AND Y IN ORDER \
   OF INCREASING X
```

Blank lines can be inserted anywhere between statements of the source program to set apart one segment from another.

THE WHILE. . .WEND CONSTRUCTION

Another unique feature of CBASIC is the WHILE. . .WEND loop found in block-structured languages. This method of looping is different from the usual BASIC FOR. . .NEXT construction. The loop is defined by the statement pair:

```
WHILE >logical expression>
. . .
. . .
WEND
```

Looping continues as long as the logical expression is true (not equal to zero) and terminates if the expression is false (equal to zero).

A CROSS-REFERENCE LISTING

Yet another feature of CBASIC is a separate executable program called XREF. It can be used to generate a cross reference listing of functions and variables in any BASIC source program. The resulting alphabetical listing gives the number of each line that references the particular identifier. XREF can be directed to list the resulting file on the line printer or to generate a disk file.

BCD CALCULATIONS

The BASICs offered by Microsoft and by Xitan perform operations such as multiplication and division using binary arithmetic routines. Most other BASICs, including CBASIC, are programmed to do BCD arithmetic. Each method has its advantages and disadvantages.

Binary arithmetic is considerably faster than BCD arithmetic, but tends to introduce roundoff error. Thus Microsoft and Xitan BASIC are ideal for scientific calculations where five or six figures of precision are usually sufficient. (Microsoft BASIC has a double-precision representation with an accuracy of 17 digits, and Xitan BASIC always has a precision of 11 digits.)

CBASIC performs its calculations in BCD with a precision of 14 decimal digits. The sacrificing of speed for precision in representation is reasonable in a business-oriented language. A balance of $132,324.18 must not appear sometimes as $132,324.19. Furthermore, business operations involve large amounts of printed output, compared to the usual scientific (or game-playing) application. Since business programs are inherently slowed by the printer speed, the increased calculation time of BCD arithmetic is not so important.

Another advantage of BCD arithmetic is the increased dynamic range. Floating-point numbers represented in binary form are usually limited to a range of ten to the power 38. CBASIC can represent numbers up to ten to the power 63.

TYPING OF VARIABLES

Most BASICs have at least two variable types, real and string:

```
A$ = "XYZ CORPORATION"
A  = 38.27
```

String variables are indicated by the dollar-sign suffix. With CBASIC, the user can define a third type: integer variable. Integer variables are denoted by a percent sign at the end of the name:

```
N% = 30
```

Constants that do not contain decimal points or exponential notation are also stored as integers (if they are not too big).

Integer variables are stored in two bytes rather than the five bytes used for floating-point numbers. Integers are represented in binary form and so have a range of −32768 to +32767. They should especially be used for loop variables wherever possible:

```
For I% = 1 TO N%
```

They can also be used to represent inventory items which, of course, will always be integer quantities.

GLOBAL VARIABLES

A major disadvantage of BASIC (including CBASIC) compared to FORTRAN is that all variables are global (except in user-defined functions). Variables in FORTRAN are local to each subprogram. A FORTRAN subroutine written to sort the array X of length N can also be used to sort the array B of length K:

```
CALL SORT(X,N)
. . . .
CALL SORT(B,K)
. . . .
. . . .
SUBROUTINE SORT(X,N)
. . . .
```

With BASIC the problem is more difficult to handle. Either a second sort routine must be written for B and K, or the array B must be copied into the array X before calling the sort routine. After sorting, the results must be copied back into array B from X.

USER-WRITTEN FUNCTIONS

The user can write his own functions in BASIC as in FORTRAN. While the types of operations that can be performed by this means are limited, the technique does offer the advantage of local variables. And with CBASIC, user-written functions may occupy more than one line. A user-written function can generate the inverse sine and cosine from the inverse tangent:

```
DEF FNPI = 3.14159265
DEF FN.ASIN(X) = ATN(1/SQR(1/(X*X)-1))
                 *180/FNPI
DEF FN.ACOS(X) = ATN(SQR(1/X*X)-1))*180/FNPI
DEF FN.ATAN(X) = ATAN(X)*180/FNPI
```

The command:

```
PRINT "THE ANGLE IS";FN.ACOS(0.8)
```

will print the angle (in degrees) whose cosine is 0.8. The function FNPI, which defines the mathematical value of pi, is used to convert the results of the other three functions from radians to degrees.

Another use for a function would be to pad out strings to the desired block size for a disk file. Suppose that 20 spaces are allocated for a name field and 15 spaces for an address field. The user enters names and addresses from the console keyboard as requested by the BASIC program:

```
NAME? <user enters name and carriage return>
ADDR? <user enters address and CR>
```

The LINE INPUT command should be used for input of this type, since punctuation can then be included in the data.

```
LINE INPUT "NAME ";NAME$
LINE INPUT "ADDR ";ADDR$
```

Since names and addresses will be of varying lengths, the input data should be filled out with blanks to the desired length. This can be easily done with a function:

```
DEF FN.BLOCK$(NAME$,LENGTH%) = \
      LEFT$(NAME$ + "                    ",LENGTH%)
```

After a name and address are input, they can be blocked to the proper size with the command:

```
NAME$ = FN.BLOCK$(NAME$,20)
. . .
ADDR$ = FN.BLOCK$(ADDR$,15)
```

FORMATTED OUTPUT

CBASIC has another feature required of a business-oriented language: the ability to format the outputted data. The usual BASIC output is left-adjusted. A column of figures representing an inventory would look a little strange:

```
13
2
127
2248
```

because all the numbers are aligned along the left side. With CBASIC (as with all extended BASICs), numbers can be formatted in the more usual manner by means of the PRINT USING statement. For example, the above numbers can be printed in several acceptable ways with the statements:

```
B$ = "####  #.###^  ####.#"
A(1)=13 : A(2)=2 : A(3)=127 : A(4)=2284
FOR I% = 1 TO 4
PRINT USING B$; A(I%), A(I%), A(I%)
NEXT I%
```

produces the output:

```
  13   1.300E 01     13.0
   2   2.000E 00      2.0
 127   1.270E 02    127.0
2248   2.248E 03   2248.0
```

Dollar signs and commas can be replaced in the output. The dollar sign appears at the beginning of the string specification. Commas will appear between each group of three digits if a comma appears in the string.

```
PRINT USING "$####,###.##"; 123456.78
```

gives:

```
$123,456.78
```

MACHINE-LANGUAGE LINKAGE

It is sometimes more efficient to write a routine in assembly language and call it from BASIC. There are several commands in CBASIC that are useful for this purpose. BASIC constants are usually interpreted as decimal numbers, but hexadecimal and binary representations are more convenient for assembly-language references.

Hexadecimal constants in CBASIC are identified by a suffix H and a leading decimal number (which may be zero). The other digits may be any of the legitimate HEX characters 0-9 and A-F. The following are examples of HEX constants:

```
DPORT% = 20H
MEMS% = 0F800H
```

Binary representation of numbers is indicated by a suffix B.

The 8080 input ports can be read with the BASIC function:

```
INP(DPORT%)
```

and a byte can be sent to an output port with the function:

```
OUT DPORT%, DATA1%
```

Although the arguments for both of the I/O functions are two-byte integers, only the low-order byte is used.

Memory locations can be read with the PEEK function and can be changed with the POKE function. CP/M allows the user to incorporate an IOBYTE feature into the interface routines. The value of the IOBYTE at address 3 indicates the current assignment of up to 16 physical devices to the four CP/M logical devices: CONSOLE, LIST, PUNCH, and READER. If this feature has been implemented, the PEEK and POKE functions can be used by CBASIC to change the peripheral assignment.

A link to machine-language routines is effected with the statement:

```
CALL <address>
```

where the call address is given as the argument. Data can be interchanged between the two programs with the PEEK and POKE functions. The machine-language routine can change all of the 8080 registers except the stack pointer. An 8080 RET instruction returns control to CBASIC.

DISK FILES

ASCII data files can be created on disk with CBASIC as with other disk BASICs. The desired format for the data can be obtained by blocking the data with the LEFT$ as described above, or with the PRINT USING command. Both sequential and random-access modes are available. A typical approach for the handling of business records would be to create a disk file by sequential access, then update the file by random access. Several examples of disk-file techniques are given in the user manual.

THE INCLUDE DIRECTIVE

The CBASIC compiler can be directed to insert a disk file into the BASIC source code during the compile step. Routines used for such tasks as sorting, input, output and the handling of disk data files can be set up as separate disk files (with the file type of BAS).

The command:

```
%INCLUDE DISKIO
```

placed in a main BASIC program will generate the appropriate code for the intermediate file. The original lines of the INCLUDE file will be given in the source listing immediately following the %INCLUDE command.

An equals sign is printed after the line number to distinguish INCLUDE statements from the regular lines of source code. A routine which is inserted in a main program with a %INCLUDE statement can itself contain a %INCLUDE statement. In fact, %INCLUDE commands can be nested to six levels.

CONCLUSION

This review has been limited to some of the more interesting features of CBASIC. Microsoft's MBASIC, which is written as an interpreter, and CBASIC with its compiler/interpreter structure make a nice complementary package for the more complicated types of programming.

MBASIC can be used to write and debug a new program, then the program can be converted to CBASIC. Of course, this approach means that some of the powerful CBASIC features such as long variable names and the %INCLUDE command cannot be implemented, at least not during the debugging stage. However, this approach was used to compare the relative speeds of CBASIC and MBASIC.

A program written in MBASIC for solving simultaneous linear equations by a Householder technique was converted to CBASIC (with relative ease). Timing comparisons for up to 14 equations indicated that MBASIC and CBASIC produce the solution in about the same length of time. In both of these versions, all loop variables were defined as integers to increase the speed.

While CBASIC does not seem to offer any real advantage over MBASIC for general mathematical operations (except for the price), CBASIC is definitely more suitable for business operations.☐

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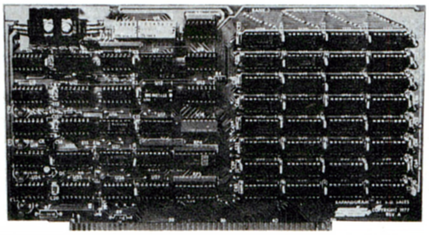

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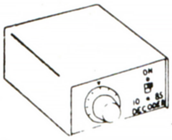

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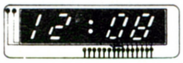

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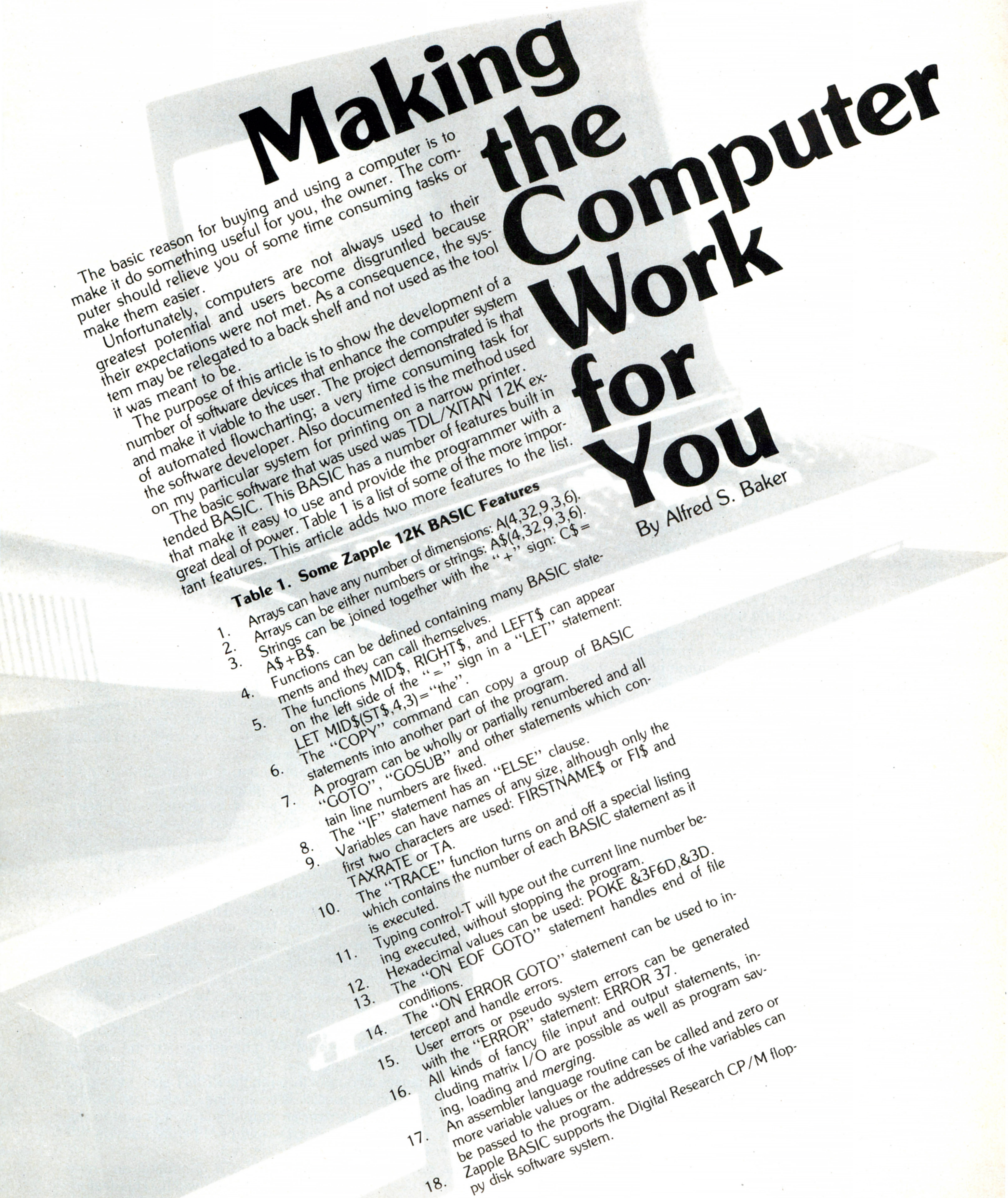

Making the Computer Work for You

By Alfred S. Baker

The basic reason for buying and using a computer is to make it do something useful for you, the owner. The computer should relieve you of some time consuming tasks or make them easier.

Unfortunately, computers are not always used to their greatest potential and users become disgruntled because their expectations were not met. As a consequence, the system may be relegated to a back shelf and not used as the tool it was meant to be.

The purpose of this article is to show the development of a number of software devices that enhance the computer system and make it viable to the user. The project demonstrated is that of automated flowcharting; a very time consuming task for the software developer. Also documented is the method used on my particular system for printing on a narrow printer.

The basic software that was used was TDL/XITAN 12K extended BASIC. This BASIC has a number of features built in that make it easy to use and provide the programmer with a great deal of power. Table 1 is a list of some of the more important features. This article adds two more features to the list.

Table 1. Some Zapple 12K BASIC Features

1. Arrays can have any number of dimensions: A(4,32,9,3,6).
2. Arrays can be either numbers or strings: A$(4,32,9,3,6).
3. Strings can be joined together with the "+" sign: C$=A$+B$.
4. Functions can be defined containing many BASIC statements and they can call themselves.
5. The functions MID$, RIGHT$, and LEFT$ can appear on the left side of the "=" sign in a "LET" statement: LET MID$(ST$,4,3)="the".
6. The "COPY" command can copy a group of BASIC statements into another part of the program.
7. A program can be wholly or partially renumbered and all "GOTO", "GOSUB" and other statements which contain line numbers are fixed.
8. The "IF" statement has an "ELSE" clause.
9. Variables can have names of any size, although only the first two characters are used: FIRSTNAME$ or FI$ and TAXRATE or TA.
10. The "TRACE" function turns on and off a special listing which contains the number of each BASIC statement as it is executed.
11. Typing control-T will type out the current line number being executed, without stopping the program.
12. Hexadecimal values can be used: POKE &3F6D,&3D.
13. The "ON EOF GOTO" statement handles end of file conditions.
14. The "ON ERROR GOTO" statement can be used to intercept and handle errors.
15. User errors or pseudo system errors can be generated with the "ERROR" statement: ERROR 37.
16. All kinds of fancy file input and output statements, including matrix I/O are possible as well as program saving, loading and *merging*.
17. An assembler language routine can be called and zero or more variable values or the addresses of the variables can be passed to the program.
18. Zapple BASIC supports the Digital Research CP/M floppy disk software system.

Table 2. Zapple Device Structure

Logical Device	Physical Device	Assignment Command	My "Device"
CONSOLE	TTY	AC=T	---
	CRT	AC=C	Keyboard, TV, Printer[1]
	BATCH[2]	AC=B	Doesn't apply
	USER	AC=U	Disk EXEC Support and BASIC Monitor Control
READER	TTY	AR=T	---
	PAPER TAPE	AR=P	Paper Tape Reader
	CASSETTE	AR=C	Tarbell Cassette
	USER	AR=Ufilename	Named Floppy Disk File
PUNCH	TTY	AP=T	---
	PAPER TAPE	AP=P	---
	CASSETTE	AP=C	Tarbell Cassette
	USER	AP=Ufilename	Named Floppy Disk File
LIST	TTY	AL=T	---
	CRT	AL=C	Keyboard, TV, Printer[1]
	LINE PRINTER	AL=L	Special Function CRT[3]
	USER	AL=Ufilename	Named Floppy Disk File

1. Special function key causes output to TV to echo on printer.
2. Commands are taken from the device assigned to the READER and console output is sent to the device assigned to the LIST.
3. Performs special listing functions which are different for each program which uses this device. (It only prints assembler output lines if they contain an error message, for example.)

TWO IMPROVEMENTS

The TDL/XITAN Zapple BASIC didn't do everything that was necessary for the type of development work I am engaged in. Specifically, the ability to use monitor commands from within a BASIC program was a very necessary item. For example, it would be useful to be able to put a monitor command in a string variable, call the monitor to execute it, and get the output from the command back in another string variable.

Another important feature was a method of producing decent hardcopy output on a 40-column hobby printer. This is important so that wide reports could be printed on the narrow device, then cut and pasted together to form the larger, more meaningful report.

CONTROLLING THE MONITOR

All TDL/XITAN software products rely on the Zapple monitor for I/O support. Table 2 is a list of the support supplied.

There are commands in BASIC which allow the program to read data in from the reader device and "punch" or list data out to the punch or list devices. Unfortunately, there is no way to assign these devices within a program. This makes it impossible to run a program which needs to read from more than one file or write to more than two files.

Example 1 is a program that reads from several disk files. The monitor commands in statements 20 and 140 are the ones used on my system to allocate disk files with the Zapple monitor. Persons who have written similar routines can substitute the appropriate commands at these points.

The monitor has a command for loading and running programs. As long as they do not occupy the same space as BASIC, they can be executed by a BASIC program. For instance, Example 2 uses the new BASIC statement "DELETE" to delete or remove a disk file. New statements such as this can be run in any unreserved portion of memory such as the available 1K on the SMB 2 monitor board.

Beginning with Line 140 in Example 2, an improvement has been made to the Zapple monitor. The jump table for the Zapple user command 'k' is used to point to the FDOS command routine. The CALL instruction in the FDOS command, which prompts for the next command, jumps back to the Zapple prompt instead. Changing these two instructions makes it possible to use the FDOS run command from the monitor and therefore from a BASIC program. If a different disk system is used, replace this command with whatever procedure is normally used for executing programs with the monitor. The point is that whichever way it's done, it can now be done from a BASIC program.

CONTROLLING THE PRINTER

The only way to make a report that is wider than the printer is to cut and paste. Let me use an example. Suppose you have an 80 column printer, but the report you want to print is 140 columns wide. First, run the whole report but only print the first 80 columns of each line. Then run the whole report but only print the last 60 characters of each line. The two reports are then pasted side by side.

This may seem to be messy and time consuming, but it can drastically improve the presentability of the data, especially when bar charts, graphs, or diagrams are being produced. However, the time required to tape together the final product is nothing compared to the problem of programming a report such that only columns 1 through 80 or columns 81 through 140 are printed.

Example 3 shows a portion of a report program. The width of the report is a program variable. The report is printed by the routine beginning at Line 1000 (not shown). Each line of the report contains a 12-character state name field followed by a 12-digit number field for each year being reported. Since the number of years can vary, the width of the report is computed and placed in the variable "W" at statement 20.

In statements 30 through 60 the program prints the report as many times as required, depending on the width of the report and a limitation of 40 characters per line on my printer. Look at statement 40. The routine at location $A100_{16}$ causes all output through the PRINT statement to be routed through a special filter routine. This filter routine counts each character on an output line as it is sent to the printer. All characters which would print before position "I" or after position "I+38" are ignored.

The routine at Line 1000 thinks it is printing an entire report. It doesn't worry about the page width. This feature

Flowchart 1

```
  CHART- INITIALIZATION AND USER INPUT.

A01                 A02                 A03                 A04                 A05

  -----------
 /           \
(    CHART    )                                                   /-\
 \           /                                                   !B04!
  -----------                                                     \-/
       !                                                           !
       !                                                           !
       V                                                           V
B01-----------+     B02                 B03                 B04---------+-+     B05
!INITIALIZE   !                                             ! !  FNC    ! !
!FUNCTIONS,   !                                             ! !(5.10)   ! !
!DATA SPACE,  !                                             ! ! OPEN    ! !
!CONSOLE,     !           /-\                               ! !OUTPUT   ! !
!AND PUNCH.   !          !D02!                              ! ! FILE    ! !
+-------------+           \-/                               +-+---------+-+
       !                   !                                       !
       !                   !                                       !
       V                   V                                       V
C01   /-\           C02    !            C03                 C04   /-\           C05
   /-/   \-\               !                                   /-/   \-\          -----------
 /           \   NO        !                                 /           \  YES  /           \
<    PRINT    >---->-------+                                <     OK      >---->(    SETUP    )
 \   ONLY    /             !                                 \           /       \  (5.02)   /
   \-\ ? /-/               !                                   \-\ ? /-/          -----------
      \-/                  !                                      \-/
       !                   !                                       !
       !YES                !                                       !NO
       V                   V                                       V
D01-----------+     D02-----------+     D03                 D04   /-\           D05
!GET INPUT    !     !GET INPUT    !                            /-/   \-\
!FILE NAME    !     !FILE NAME    !                          /  ALREADY  \   NO
!             !     ! AND         !                         <   EXISTS    >---->-------+
!             !     !OUTPUT       !                          \           /             !
!             !     !FILE NAME    !                            \-\ ? /-/               !
+-------------+     +-------------+                               \-/                  !
       !                   !                                       !                   !
       !                   !                                       !YES                !
       V                   V                                       V                   V
E01-----------+     E02---------+-+     E03                 E04   /-\           E05---------+-+
!GET NUMBER   !     ! !  FNC    ! !                            /-/   \-\        ! !  FNE    ! !
!OF CELLS     !     ! !(5.10)   ! !      /-\                 /           \   NO ! !(5.10)   ! !
!ACROSS PAGE  !     ! !  OPEN   ! !<----!E02!               <    REUSE    >---->! ! ERROR   ! !
!FOR THIS     !     ! ! INPUT   ! !      \-/                 \    FILE   /      ! !  MSG    ! !
!FLOWCHART    !     ! !  FILE   ! !                            \-\ ? /-/        ! !         ! !
+-------------+     +-+---------+-+                               \-/           +-+---------+-+
       !                   !                                       !                   !
       !                   !                                       !YES                !
       V                   V                                       V                   V
F01----------       F02   /-\           F03---------+-+     F04---------+-+     F05   /-\
 /           \         /-/   \-\        ! !  FNE    ! !     ! !  FNC    ! !          !D02!
(    PRINT    )      /           \   NO ! !(5.10)   ! !     ! !(5.10)   ! !           \-/
 \  (5.11)   /      <     OK      >---->! ! ERROR   ! !     ! ! DELETE  ! !
  -----------        \           /      ! !  MSG    ! !     ! ! OUTPUT  ! !
                       \-\ ? /-/        ! !         ! !     ! !  FILE   ! !
                          \-/           +-+---------+-+     +-+---------+-+
                           !                   !                   !
                           !YES                !                   !
                           V                   V                   V
G01                 G02   /-\           G03   /-\           G04   /-\           G05
                         !B04!               !D02!               !E02!
                          \-/                 \-/                 \-/
```

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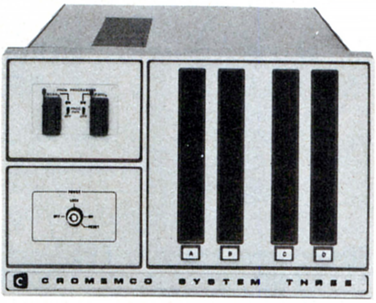

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has been used to print some very useful and rather impressive reports with considerable ease, all on a 40 column wide printer. The flowcharts printed by the program CHART are excellent examples. Another interesting set of examples are the various BASIC program listings. Calling A100 just before using the "LIST" command works very nicely.

HOW IT WORKS

At the beginning of each listing is a complete description of the parameters the program expects: how the user codes them in the BASIC program and what they look like as passed by the BASIC interpreter to the called routine. At the end of the first assembly listing are the descriptions of the Zapple monitor routines which these programs call. If the monitors have been loaded into a different area of memory, they should be changed appropriately.

Notice the funny line "%ZPGSYSMCX" in the listings. This is a modification to the assembler which causes it to automatically insert source from additional files on disk. This statement caused the Zapple routine definitions to be added to the two programs. When typing in the programs, just leave this line out.

USING THE PROGRAMS

The user decides what the flowchart will look like; the computer is the draftsman. Describe the flowchart to the computer, and it draws a neat, hassle-free copy.

THE FLOWCHARTING PAGE

Flowchart 1 depicts a typical flowchart page. The top of the page can contain as many title lines as needed. The remainder of the page is broken down into flowchart element areas called cells. Each cell can contain only one flowcharting symbol such as a procedure block, decision block or line (the flowcharting symbols are described in Table 3). The limit on the number of cells across the page horizontally is 14. There is no limit to the number of cells vertically down the page.

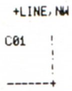
Table 3. The Flowcharting Symbols

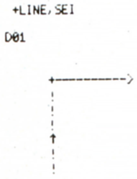
Element Line	Operands	Description	Examples
+DONE	none	This is the last line read by the program. It tells the program to begin drawing the flowchart.	
+HOOK	arw,xnn	This element generates the label flowcharting symbol. The operand "xnn" is placed in the symbol. The "arw" operand is the arrow indicator. With the +HOOK symbol it also describes where in the cell the symbol is to be placed. It can be any of the characters: "T" for top of cell, "L" for left side of cell, "B" for bottom of cell, or "R" for right side of cell. If "B" or "R" is chosen, the suffixes "I" or "O" can be added to create an inward or outward pointing arrow from the bottom or right of the symbol. If either of these suffixes are chosen, the additional suffixes "Y" or "N" can be added to label the arrow with a "YES" or "NO".	

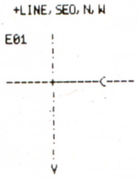
```
  +HOOK,T,G03

 A01  /-\
     !G03!
      \-/


+HOOK,RIY,B04

B01

         /-\   YES
        !B04!<----
         \-/
```

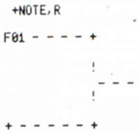
Element Line	Operands	Description	Examples
+LINE	ddrw,x,x	This element generates a line on the flowchart. "dd" describes the primary path of the line through the cell. It	

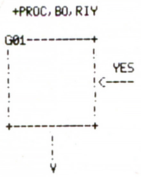
		can have any of six values: "NS" for a straight line vertically through the cell, "EW" for a straight line horizontally through the cell, or the values "NW", "NE", "SW" or "SE" for a 90° angle line entering the cell at those compass points. "RW" is optional and represents the same "I", "O", "Y", and "N" suffixes as described in the +HOOK element above. These suffixes apply only to the East or South branch of a line and thus cannot be used when the line chosen is "NW". If the line is "SE", the suffixes apply to the South branch. The East branch in this case would have the same suffixes applied automatically but with the direction of the arrow reversed. The "x" operands are also optional. They are used to add a North, "N" or West, "W", branch to the primary path of the line through the cell.
+NEXT	none	This element tells the program that there are no more symbols on this row of the flowchart.
+NOTE	d	This element generates a commentary block and is the only symbol which steps outside of its cell. "d" defines whether the comments apply to the flowchart symbol to the right, "R", or to the left, "L". If the commentary block applies to the symbol to the left, the connecting dashed line will overlay the right arrow area in that symbol's cell. After this element line, up to five lines of data can be entered. The first 11 characters of each data line will be placed in the commentary block.
+NULL	none	This element generates an empty cell. We must invent a zero.
+PROC	arw,arw	This element generates a procedure block. None, one, or two arrows can be defined with this block using a "B" for a bottom arrow or an "R" for a right arrow. The suffixes "I", "O", "Y" or "N" can also be used. After this element line, up to five lines of data can be entered. The first 11 characters of each line will be placed in the procedure block.
+TASK	arw,arw	This element generates a subroutine call block. None, one or two arrows can be defined with this block in the same way as with the "+PROC" block above.

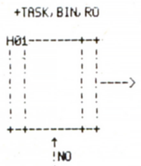












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		After this element line, up to five lines of data can be entered. The first seven characters of each line are placed in the block.
+TERM	arw	This element generates a terminator/originator block. As with the "+HOOK" element, the "arw" operand also defines where in the cell the block is to be placed. It can have any of three values: "T" for the top of the cell, "M" for the middle of the cell, and "B" for the bottom of the cell. If it is placed in the middle of the cell, a right arrow can be defined using the four suffixes "I", "O", "Y" and "N". If it is placed at the bottom of the cell, these suffixes can be used to describe a bottom arrow. Up to three data lines can be entered after this element. The first nine characters of the first one, the first eleven characters of the second one, and the first nine characters of the third one are placed in the block.
+TEST	arw,arw	This element generates a decision block. None, one or two arrows can be generated in exactly the same way as with the "+PROC" element described above. Also, up to three lines of data can be entered after the element. The first nine characters of the first line, the first eleven characters of the next line, and the first nine characters of the last line are entered into the block.
+TITL	none	This element tells the charting program to place all of the data lines which follow into the title area of the flowcharting page.

```
 +TERM,MIY

I01
  ---------
 /         \   YES
(           )<----
 \         /
  ---------
```

```
 +TERM,BO

J01

  ---------
 /         \
(           )
 \         /
  ---------
      !
      !
      V
```

```
 +TEST,BOY,RON

K01  /-\
   /-/   \-\
  /         \     NO
 <           >----->
  \         /
   \-\ ? /-/
      \-/
       !
       !YES
       V
```

THE FLOWCHARTING SYMBOLS

Refer back to Table 3. Three of the element line types do not use up a cell on the flowchart page. These are the control types. The "+TITL" line type tells CHART, the flowcharting program, that the following lines of data are to be placed at the top of the next page.

The "+NEXT" line type is the flowcharting program equivalent to the carriage return. The cells on the page are filled from left to right. When the program encounters this line, it goes back and begins with the first cell in the next horizontal row of cells.

The "+DONE" element line signals that there is no more input, and it is time to print out the finished flowchart. The other element line types describe the various flowcharting symbols. The first value in the line names the type of symbol that is to be produced. The remaining values on the line describe various attributes of the symbol.

The symbols are placed in the upper left corner of the cells (see Flowchart 1). Any arrows connecting the symbol to another symbol must be drawn to the right or below the symbol. When reviewing the various flowcharts, you will discover that this is not a restriction on how symbols can be connected. In fact, it provides a rather elegant view of the flowcharting process.

```
+TITL
FLOWCHART 5.01: THE CHARTING PROGRAM
  CHART — INITIALIZATION AND USER INPUT.
+TERM,BO

   CHART
+NULL
+NULL
+HOOK,BO,BO4
+NEXT
+PROC,BO
INITIALIZE
FUNCTIONS,
DATA SPACE,
CONSOLE,
AND PUNCH.
+HOOK,BO,DO2
+NULL
+TASK,BO
  FNC
(5.10)
 OPEN
OUTPUT
 FILE
+NEXT
+TEST,BOY,RON

   PRINT
  ONLY
+LINE,SWO,N
+NULL
+TEST,BON,ROY

   OK
+TERM,M

  SETUP
 (5.02)
+NEXT
+PROC,BO
GET INPUT
FILE NAME
+PROC,BO
GET INPUT
FILE NAME
  AND
OUTPUT
FILE NAME
+NULL
+TEST,RON,BOY
  ALREADY
   EXISTS
```

Figure 1.

For most of the symbols, the arrows connecting them to other symbols are described by a simple and obvious mechanism. The value "BOY" describes a arrow at the **b**ottom of the symbol with the arrow head directed **o**ut away from the symbol and the word "**Y**ES" printed beside the arrow. In the table, these general arrow descriptions are referred to as "arw".

The best way to learn how to use the symbols and the charting program is to work through an example. Once you begin using CHART, refer back to Flowchart 1 and the program listings.

BUILDING THE FLOWCHART

The first step toward getting the computer to draw a flowchart is to know what flowchart is desired. Flowchart 1 is a flowchart that I want the computer to draw for me. The general flow is laid out with the flowcharting cells.

Figure 1 is an example of an input file created using the Zapple editor to describe the flowchart to the computer. The

```
+LINE,SWO
+NEXT
+PROC,BO
GET NUMBER
OF CELLS
ACROSS PAGE
FOR THIS
FLOWCHART

+TASK,BO,RI
   FNC
(5.10)
   OPEN
  INPUT
   FILE
+HOOK,L,E02
+TEST,RON,BOY

     REUSE
     FILE
+TASK,BO
     FNE
(5.10)
  ERROR
   MSG
+NEXT
+TERM,T

     PRINT
  (5.11)
+TEST,RON,BOY

     OK
+TASK,BO
   FNE
(5.10)
  ERROR
   MSG
+TASK,BO
   FNC
(5.10)
  DELETE
  OUTPUT
   FILE
+HOOK,T,D02
+NEXT
+NULL
+HOOK,T,B04
+HOOK,T,D02
+HOOK,T,E02
+NEXT
+DONE
```

contents of each cell are described horizontally across the page.

Once you get the hang of it, it takes only a few minutes to convert a rough draft of a flowchart into an input file for CHART. When run, CHART decides on what to do by asking questions. The program keeps asking questions until it is satisfied, and then it goes to work. The result is a flowchart which may or may not resemble the flowchart that you thought you told the computer to draw. Before blaming the computer, check out your input file. For our example, Flowchart 1 is the result.

Now you have a print file that contains the flowchart you like. To get more than one copy, rerun CHART and tell it to print this file. It is as easy as dropping a bit.

GETTING THE PROGRAM TO WORK

Several changes will probably be required in order to get CHART to work in your system. Use the command that you load BASIC and other programs with in place of the "K" command used here. You also have a method of allocating disk files with your monitor if you have a disk. Replace my disk assignment commands with your own. If tape is used, replace these commands with your own tape assignment commands.

There is a problem for those with only one tape drive. Since CHART is designed to read from its input file and write to the flowchart print file at the same time, it requires two tape drives. The best way to fix this problem is to load the input file into a string variable table. Then the tape drive is free to be used for the print file after the table has been loaded.

I've tried to make the program as generally usable as possible within the constraints of one particular version of BASIC and one particular floppy disk system. In the listing of CHART I've used the "*" to mark off those areas which may need to be changed, and I have tried to explain each of these pieces of code as well as possible. Hopefully, they can be easily changed to fit your system.

SUMMARY

You can now execute any monitor command under program control. You can run other programs from tape or disk as specialized BASIC "statements." You can even dynamically load these routines with the monitor and then pass values to them using the Zapple BASIC "CALL" statement. Finally, it is now much easier for you to print reports which are not limited to the width of your printer.

The great part about all this was that it was done without modifying Zapple BASIC. TDL/Xitan has done an excellent job of putting together a powerful software system for the hobbyist. Not only are their products designed with plenty of excellent built-in features, but they make it easy to improve upon them.

Finally, with CHART you now have an effective way of converting a rough draft into a polished flowchart. You've eliminated the hassle of template and ink, and you have put your computer to work in a new way.☐

EXAMPLE 1

```
  1 REM ALLO ALLOCATING FILES
  2 REM FROM WITHIN A ZAPPLE BASIC PROGRAM
 10 R$="                    "          'THE ANSWER WILL GO HERE
 20 A$="AR=UINFILE A" + CHR$(13)  'THE MONITOR COMMAND
 30 REM THE STATEMENT ON LINE 20 WILL ISSUE THE ZAPPLE MONITOR
 40 REM ASSIGNMENT COMMAND TO ALLOCATE THE READER DEVICE TO THE
 50 REM DISK FILE 'INFILE A'.   THE COMMAND IS PASSED IN THE
 60 REM STRING 'A$' AND ANY REPLIES TO THE COMMAND WILL BE
 70 REM PLACED IN THE STRING 'R$'.  'R$', MUST BE LONG ENOUGH
 80 REM TO PICK UP AS MUCH OF THE REPLY AS WANTED.
 90 CALL &A000,VARADR(A$),VARADR(R$)
100 REM UNIT #1 IS ALWAYS THE READER FILE IN ZAPPLE BASIC
110 REM READ VARIABLES A,B,C,D,D$ FROM FILE INFILE A:
120 INPUT #1,A,B,C,D$
130 REM WE WILL NOW ALLOCATE A DIFFERENT READER DISK FILE
140 A$="AR=UNIFILE B" + CHAR$(13)
150 CALL &A000,VARADR(A$),VARADR(R$)
160 REM READ VARIABLES E$,F,G FROM FILE INFILE B
170 INPUT #1,E$,F,G
180 REM AND SO ON ...
```

EXAMPLE 2

```
  1 REM LDEX LOADING AND EXECUTING AN ASSEMBLY PROGRAM
  2 REM AS PART OF A BASIC PROGRAM.
 10 REM IN THIS EXAMPLE THE BASIC PROGRAM CREATES A LONG
 20 REM COMMAND STRING CONTAINING SEVERAL MONITOR COMMANDS
 30 REM THE COMBINED RESULT OF THESE COMMANDS IS TO:
 40 REM  1. LOAD THE FILE DELETE PROGRAM
 50 REM  2. EXECUTE IT
 60 REM  3. TELL IT TO DELETE THE DISK FILE 'OLDFIL'
 70 REM
 80 A$="AR=UDELETE" + CHR$(13)     'ASSIGN READER TO PROG
 90 A$=A$+"R,AE00" + CHR$(13)      'LOAD IT INTO MEMORY
100 A$=A$+"GAE00" + CHR$(13)      'EXECUTE IT
110 A$=A$+"OLDFIL" +CHR$(13)      'IT READS THE FILENAME
120 R$="                    "      'HERE'S THE ANSWER PLACE
130 CALL &A000,VARADR(A$),VARADR(R$)  'DELETE FILE 'OLDFIL'
140 REM
```

EXAMPLE 2 Continued

```
150 REM IF YOUR MONITOR HAS A COMMAND WHICH CAN LOAD AND RUN
160 REM A PROGRAM DIRECTLY, OR IT CAN BE USED TO JUMP TO
170 REM YOUR FLOPPY DISK SUPPORT FOR THIS, THEN THE COMMANDS
180 REM IN STATEMENTS 80 THROUGH 110 CAN BE REPLACED BY
190 REM A SINGLE STATEMENT.  SINCE I CHANGED THE JUMP
200 REM INSTRUCTION FOR THE UNUSED "K" COMMAND TO POINT TO
210 REM THE FDOS RUN COMMAND, THEN I USE THE FOLLOWING
220 REM SEQUENCE:
230 REM
240 A$="KR DELETE OLDFIL"        'LOAD AND EXECUTE DELETE COMMAND
250 R$="                "        'HERE'S THE ANSWER AREA
260 CALL &A000, VARADR(A$), VARADR(R$)     'DO IT!
```

EXAMPLE 3

```
 1 REM VARPR PRINTING A VARIABLE WIDTH REPORT ON
 2 REM A NARROW PRINTER.
10 INPUT "NUMBER OF YEARS";Y
20 W=12+12*Y              'WIDTH OF REPORT
30 FOR I = 1 TO W STEP 39
40   CALL &A100, I, I+38
50   GOSUB 1000            'GO PRINT THE REPORT
60 NEXT I
```

LISTING 1

```
                   ; THIS ROUTINE IS CALLED AS:
                   ; CALL &A000,VARADR(CMD$),VARADR(ANS$)
                   ;
                   ; ON INPUT:
                   ;
                   ; BC=2 (NUMBER OF PARAMETERS)
                   ; SP->
                   ; ADDRESS OF DOPE VECTOR FOR REPLIES
                   ; ADDRESS OF DOPE VECTOR FOR COMMAND
                   ; HL->
                   ; ADDRESS OF RETURN POINT
                   ;
                   ; THE FORMAT OF A ZAPPLE BASIC STRING DOPE
                   ;  VECTOR IS:
                   ;
                   ; 1 BYTE LENGTH
                   ; 1 BYTE ALWAYS ZERO
                   ; 2 BYTE ADDRESS OF STRING
                   ; 2 BYTES UNUSED
                   ;
A000                       .LOC 0A000H
                   ; HERE IS THE ENTRY POINT. THE FIRST
                   ; THING TO DO IS VERIFY THAT THERE ARE
                   ; TWO PARAMETERS. IF NOT, RETURN.
A000                       A000:
A000     78                MOV A,B
A001     B7                ORA A
A002     206F              JRNZ ..INE
```

```
                   ; FORMER CONTENTS OF THE CONSOLE USER
                   ; OUTPUT DEVICE JUMP ADDRESS (COLOC+1)
                   ; IN OUR HOLDING AREA (OLDOUT).
                   ; NEXT WE SAVE THE FORMER CONTENTS OF
                   ; THE CONSOLE USER INPUT DEVICE JUMP
                   ; ADDRESS (CILOC+1) IN OUR HOLDING
                   ; AREA (OLDIN).
                   ; NEXT WE POINT THESE JUMP ADDRESSES
                   ; TO OUR ROUTINES:
                   ; COLOC+1 SET TO ROUTINE "OUT"
                   ; CILOC+1 SET TO ROUTINE "IN"
A03C     2A F804          LHLD COLOC+1
A03F     22 A0E4          SHLD OLDOUT
A042     2A F801          LHLD CILOC+1
A045     22 A0E6          SHLD OLDIN
A048     21 A0B5          LXI H,OUT
A04B     22 F804          SHLD COLOC+1
A04E     21 A075          LXI H,IN
A051     22 F801          SHLD CILOC+1
                   ;
                   ; NOW WE HAVE TO CAUSE ZAPPLE TO USE
                   ; THE USER CONSOLE DEVICE AS THE
                   ; CURRENT CONSOLE DEVICE.
                   ; FIRST WE OBTAIN THE CURRENT DEVICE
                   ; ASSIGNMENT IN "A" BY CALLING THE
                   ; ASSIGNMENT RETRIVE ROUTINE (IOCHK).
                   ; WE SAVE THIS DATA IN OLDASN.
                   ; NEXT WE SET THE CONSOLE DEVICE TO 3
                   ; AND PLACE THE NEW SET OF ASSIGNMENTS
                   ; IN "C" AND CALL THE SET ASSIGNMENT
                   ; ROUTINE (IOSET).
A054     CD F015          CALL IOCHK
A057     32 A0E3          STA OLDASN
A05A     F603             ORI 3
A05C     4F               MOV C,A
A05D     CD F018          CALL IOSET
                   ;
                   ; THIS LITTLE LOOP BLANKS OUT THE REPLY
                   ; STRING JUST IN CASE THE REPLY IS
                   ; SHORTER THAN THE LENGTH OF THE STRING.
A060     3A A0E8          LDA ANSL
A063     47               MOV B,A
A064     2A A0EC          LHLD ANSW
A067                      ..LP1:
A067     3620             MVI M,' '
A069     23               INX H
A06A     10FB             DJNZ ..LP1
                   ;
                   ; NOW WE TRANSFER CONTROL TO THE ZAPPLE
                   ; MONITOR INTERNAL LOOP WHICH PROCESSES
                   ; CONSOLE COMMANDS (START).  SINCE WE
                   ; PLAN ON GETTING BACK TO BASIC USING
                   ; ITS STACK AND WANT TO AVOID FUNNY
                   ; STUFF IN THE COMMANDS, WE SET UP
                   ; OUR OWN STACK FOR THE MONITOR TO USE.
                   ;
A06C     21 A400          LXI H,0A400H
A06F     F9               SPHL
A070     C3 F062          JMP START
                   ;
                   ; THIS ROUTINE IS USED TO EXIT A100 IF
                   ; THE INITIAL PARAMETERS ARE BAD. IT
                   ; ASSUMES THAT HL STILL POINTS TO THE
                   ; LOCATION IN THE STACK WHERE THE
```

```
A004    79                    MOV A,C
A005    FE02                  CFI 2
A007    206A                  JRNZ ..DNE
                     ;
                     ; NEXT WE INITIALIZE SOME VARIABLES:
                     ; CMDN IS HOW MANY CHARACTERS FROM
                     ;       THE COMMAND STRING HAVE BEEN
                     ;       SENT.
                     ; ANSN IS HOW MANY CHARACTERS OF REPLY
                     ;       HAVE BEEN RECEIVED.
                     ; FLAG BIT 0 IS ON IF THE NEXT OUTPUT
                     ;       CHARACTER IS NOT TO BE PUT IN
                     ;       THE ANSWER AREA.  THIS ELIMIN-
                     ;       ATES THE NORMAL ECHOING OF
                     ;       COMMANDS TO KEEP THE REPLY
                     ;       STRING FROM BEING CLUTTERED.
                     ; RETADR HOLDS THE LOCATION IN THE
                     ;       STACK WHERE THE RETURN
                     ;       ADDRESS IS.
                     ; ANSWER POINTS TO THE ANSWER DOPE
                     ;       VECTOR.
                     ; ANSL CONTAINS THE LENGTH OF THE
                     ;       ANSWER (= REPLY) STRING.
                     ; ANSW CONTAINS THE NEXT POSITION
                     ;       IN THE REPLY STRING TO BE
                     ;       FILLED IN WITH AN OUTPUT
                     ;       CHARACTER.
                     ; CMD CONTAINS THE LOCATION OF THE
                     ;       COMMAND STRING DOPE VECTOR.
                     ; CMDL CONTAINS THE LENGTH OF THE
                     ;       COMMAND STRING.
                     ; CMDW POINTS TO THE NEXT CHARACTER IN
                     ;       THE COMMAND STRING TO BE USED.
A009    97                    SUB A
A00A    32 A0E0               STA CMDN
A00D    32 A0E1               STA ANSN
A010    32 A0E2               STA FLAG
A013    22 A0F2               SHLD RETADR
A016    E1                    POP H
A017    22 A0EE               SHLD ANSWR
A01A    7E                    MOV A,M
A01B    32 A0E8               STA ANSL
A01E    23                    INX H
A01F    23                    INX H
A020    7E                    MOV A,M
A021    32 A0EC               STA ANSW
A024    23                    INX H
A025    7E                    MOV A,M
A026    32 A0ED               STA ANSW+1
A029    E1                    POP H
A02A    22 A0F0               SHLD CMD
A02D    7E                    MOV A,M
A02E    32 A0E9               STA CMDL
A031    23                    INX H
A032    23                    INX H
A033    7E                    MOV A,M
A034    32 A0EA               STA CMDW
A037    23                    INX H
A038    7E                    MOV A,M
A039    32 A0EB               STA CMDW+1
                     ;
                     ; NOW WE NEED TO POINT THE ZAPPLE
                     ; MONITOR TO MY OWN CONSOLE INPUT AND
                     ; OUTPUT ROUTINES. FIRST WE SAVE THE
```

```
                     ; RETURN ADDRESS TO BASIC IS FOUND.
                     ;
A073    F9           ..DNE:   SPHL
A074    C9                    RET
                     ;
                     ; THIS IS THE USER CONSOLE INPUT
                     ; ROUTINE.  THE FIRST THING IS TO TEST
                     ; IF THE NUMBER OF CHARACTERS ALREADY
                     ; USED EQUALS THE LENGTH OF THE COMMAND
                     ; STRING. IF NOT WE GO TO ..IN1 TO
                     ; RETURN THE NEXT CHARACTER AS IF FROM
                     ; THE KEYBOARD.
                     ;
A075    E5           IN:      PUSH H
A076    3A A0E9               LDA CMDL
A079    47                    MOV B,A
A07A    3A A0E0               LDA CMDN
A07D    B8                    CMP B
A07E    2021                  JRNZ ..IN1
                     ;
                     ; THEY WERE EQUAL: WE ARE DONE. HERE WE
                     ; RECOVER THE ORIGINAL CONSOLE ASSIGN-
                     ; MENT BY GETTING OLDASN AND MASKING
                     ; OFF ALL BUT THE CONSOLE ASSIGNMENT.
                     ; THIS IS SAVED IN "C". NEXT WE GET
                     ; ALL OF THE CURRENT ASSIGNMENTS EXCEPT
                     ; FOR THE CONSOLE ASSIGNMENT BY USING
                     ; "IOCHK" AND MASKING OFF THE CONSOLE.
                     ; (REMEMBER THAT THE COMMANDS IN THE
                     ; COMMAND STRING MAY HAVE CHANGED THE
                     ; DEVICE ASSIGNMENTS!) FINALLY THE
                     ; OLD CONSOLE ASSIGNMENT AND THE OTHER
                     ; NEW ASSIGNMENTS ARE OR'ed TOGETHER AND
                     ; SETNT TO "IOSET" FOR ACTVATION.
                     ;
A080    3A A0E3               LDA OLDASN
A083    E603                  ANI 3
A085    4F                    MOV C,A
A086    CD F015               CALL IOCHK
A089    E6FC                  ANI 0FCH
A08B    B1                    ORA C
A08C    4F                    MOV C,A
A08D    CD F018               CALL IOSET
                     ;
                     ; NOW THE OLD CONTENTS OF COLOC+1 AND
                     ; CILOC+1 ARE RESTORED FROM THE HOLDING
                     ; AREAS.
                     ;
A090    2A A0E4               LHLD OLDOUT
A093    22 F804               SHLD COLOC+1
A096    2A A0E6               LHLD OLDIN
A099    22 F801               SHLD CILOC+1
                     ;
                     ; THE LAST STEP IS TO RETURN TO BASIC.
                     ; THIS IS DONE BY RETRIEVING THE
                     ; LOCATION IN THE STACK POINTING TO THE
                     ; BASIC RETURN ADDRESS AND RETURNING.
                     ;
A09C    2A A0F2               LHLD RETADR
A09F    F9                    SPHL
A0A0    C9                    RET
                     ;
                     ; THIS LITTLE ROUTINE RETURNS A CHARAC-
                     ; TER TO A ROUTINE REQUESTING DATA FROM
```

```
                       ; THE CONSOLE "KEYBOARD". FIRST WE
                       ; UPDATE THE COUNT OF CHARACTERS SENT.
                       ; NEXT WE MOV THE NEXT CHARACTER FROM
                       ; THE COMMAND STRING TO "A" AND UPDATE
                       ; THE COMMAND STRING POINTER TO POINT
                       ; TO THE NEXT CHARACTER. FINALLY, WE
                       ; TURN ON BIT ZERO OF THE FLAG BYTE TO
                       ; BYPASS THE NEXT CHARACTER SENT TO
                       ; THE ROUTINE "OUT".
                       ; THE "ORA" INSTRUCTION IS TO TURN
                       ; OFF THE CARRY BIT IF ON. THE CARRY
                       ; BIT SIGNIFIES END-OF-DATA, WHICH
                       ; WE WILL NEVER BE AT.
                       ;
A0A1    3C             ..IN1:   INR A
A0A2    32 A0E0                 STA CMDN
A0A5    2A A0EA                 LHLD CMDW
A0A8    7E                      MOV A,M
A0A9    23                      INX H
A0AA    22 A0EA                 SHLD CMDW
A0AD    21 A0E2                 LXI H,FLAG
A0B0    CBC6                    SET 0,M
A0B2    B7                      ORA A
A0B3    E1                      POP H
A0B4    C9                      RET
                       ;
                       ; THIS ROUTINE TAKES THE CHARACTERS
                       ; GOING TO THE CONSOLE OUTPUT DEVICE
                       ; AND STORES THEM IN THE REPLY STRING.
                       ; THE FIRST THING IT DOES IS TEST BIT
                       ; ZERO OF THE FLAG BYTE TO DETERMINE
                       ; IF IT IS SUPPOSED TO BYPASS THIS
                       ; OUTPUT BYTE.  IN ANY CASE, IT TURNS
                       ; OFF THE BIT.  IF THE BIT WAS ON, IT
                       ; RETURNS WITHOUT STORING THE BYTE.
                       ;
A0B5    E5             OUT:     PUSH H
A0B6    21 A0E2                 LXI H,FLAG
A0B9    CB46                    BIT 0,M
A0BB    CB86                    RES 0,M
A0BD    E1                      POP H
A0BE    79                      MOV A,C
A0BF    C0                      RNZ
                       ;
                       ; WE ALSO DON'T WANT TO STORE THIS BYTE
                       ; IF WE HAVE ALREADY RECEIVED AS MANY
                       ; BYTES AS THE LENGTH OF THE REPLY
                       ; STRING. IF WE STILL HAVE ROOM, WE GO
                       ; TO ..OUT1 TO STORE THIS BYTE.
                       ;
A0C0    E5                      PUSH H
A0C1    C5                      PUSH B
A0C2    3A A0E8                 LDA ANSL
A0C5    4F                      MOV C,A
A0C6    3A A0E1                 LDA ANSN
A0C9    B9                      CMP C
A0CA    2004                    JRNZ ..OUT1
                       ;
                       ; THE REPLY STRING IS FULL, WE WILL
                       ; RETURN WITHOUT STORING THIS BYTE.
                       ;
A0CC    C1                      POP B
A0CD    79                      MOV A,C
A0CE    E1                      POP H
```

```
                       ;
                       ; C ACCEPT CHARACTER INPUT FROM READER
                       ; I
                       ; O A=BYTE CY=EOF
                       ; K INPUT READER
                       ;
F009                        CO      =       0F009H
                       ;
                       ; C SEND OUTPUT CHARACTER TO CONSOLE
                       ; I C=BYTE
                       ; O A=BYTE
                       ; K OUTPUT CONSOLE
                       ;
F00C                        PO      =       0F00CH
                       ;
                       ; C SEND CHARACTER OUTPUT TO PUNCH
                       ; I C=BYTE
                       ; O A=BYTE
                       ; K OUTPUT PUNCH
                       ;
F00F                        LO      =       0F00FH
                       ;
                       ; C SEND OUTPUT CHARACTER TO LIST FILE
                       ; I C=BYTE
                       ; O A=BYTE
                       ; K OUTPUT LISTER
                       ;
F012                        CSTS    =       0F012H
                       ;
                       ; C RECEIVE CONSOLE INPUT READY STATUS
                       ; I
                       ; O A=255=KEY STROKE
                       ; K INPUT CONSOLE CONTROL
                       ;
F015                        IOCHK   =       0F015H
                       ;
                       ; C GET CURRENT I/O DEVICE ASSIGNMENTS
                       ; I
                       ; O A=I/O SET UP: LIPURICC
                       ; K I/O CONTROL LOOKUP ZAPPLE
                       ;
F018                        IOSET   =       0F018H
                       ;
                       ; C CHANGE CURRENT DEVICE ASSIGNMENTS
                       ; I C= NEW I/O SET UP: LIPURICC
                       ; O
                       ; K I/O CONTROL ZAPPLE
                       ;
F01B                        MEMCK   =       0F01BH
                       ;
                       ; C RETURN TOP OF MEMORY MINUS THAT
                       ; C USED BY MONITOR
                       ; I
                       ; O B=HIGH BYTE OF ADDRESS, A=LOW BYTE
                       ; K CONTROL LOOKUP MEMORY
                       ;
F01E                        BREAK   =       0F01EH
                       ;
                       ; C LEAVE PROGRAM AND GO TO MONITOR
                       ; I
                       ; O
                       ; K CONTROL
                       ;
CA4B                        FLSTAT  =       0CA4BH
```

```
A0CF     C9                 RET
                  ;
                  ; HERE WE ARE GOING TO STORE THIS REPLY
                  ; BYTE IN THE REPLY STRING. FIRST WE
                  ; UPDATE THE NUMBER OF BYTES HANDLED.
                  ; NEXT WE TAKE THE OUTPUT BYTE AND
                  ; STORE IT INTO THE NEXT POSITION IN
                  ; THE STRING AND UPDATE THIS POINTER.
                  ;
A0D0     3C       ..OUT1: INR A
A0D1     32 A0E1          STA ANSN
A0D4     C1               POP B
A0D5     2A A0EC          LHLD ANSW
A0D8     71               MOV M,C
A0D9     79               MOV A,C
A0DA     23               INX H
A0DB     22 A0EC          SHLD ANSW
A0DE     E1               POP H
A0DF     C9               RET
                  ;
                  ; HERE ARE THE DATA AREAS PREVIOUSLY
                  ; DEFINED.
                  ;
A0E0                      CMDN:    .BLKB 1
A0E1                      ANSN:    .BLKB 1
A0E2                      FLAG:    .BLKB 1
A0E3                      OLDASN:  .BLKB 1
A0E4                      OLDOUT:  .BLKW 1
A0E6                      OLDIN:   .BLKW 1
A0E8                      ANSL:    .BLKB 1
A0E9                      CMDL:    .BLKB 1
A0EA                      CMDW:    .BLKW 1
A0EC                      ANSW:    .BLKW 1
A0EE                      ANSWR:   .BLKW 1
A0F0                      CMD:     .BLKW 1
A0F2                      RETADR:  .BLKW 1
                  ;
                  ; HERE ARE THE TWO USER CONSOLE JUMP
                  ; TABLE ENTRIES.
                  ;
                          .LOC 0F800H
F800                      CILOC:   .BLKB 3
F803                      COLOC:   .BLKB 3
                  ;
                  ; THESE ARE THE IMPORTANT ROUTINES
                  ; WITHIN THE ZAPPLE MONITOR.
                  ;
                  ; C DESCRIPTION OF ROUTINE
                  ; I INPUT REQUIREMENTS
                  ; O OUTPUT REQUIREMENTS
                  ; M OTHER MODIFIED REGISTERS
                  ; K KEYWORDS
                  ;
                  ; %ZPGSYSMCX - SEE TEXT
                  ;
F003                      CI       =        0F003H
                  ;
                  ; C ACCEPT INPUT CHARACTER FROM CONSOLE
                  ; I
                  ; O A=BYTE CY=EOF
                  ; K INPUT CONSOLE
                  ;
F006                      RI       =        0F006H
```

```
                        ;
                        ; C FLAG BYTE OF OPEN DISK OUTPUT FILES
                        ; C (THIS BYTE CAN GO ANYWHERE IN
                        ; C UNUSED MEMORY; ADDED TO ZAPPLE FOR
                        ; C DISK SUPPORT.)
                        ; I
                        ; O (XXXXX210)
                        ;   2=CASSETTE 1=OPEN PUNCH DISK
                        ;   0=OPEN LIST DISK
                        ; K I/O CONTROL PUNCH LISTER DISK TAPE
                        ;
F062                          START     =       0F062H
                        ;
                        ; C DO ZAPPLE COMMANDS
                        ; I
                        ; O
                        ; K ZAPPLE CONTROL
                        ;
0000                          .END 0
A000    A000           ANSL    A0E8           ANSN    A0E1
ANSW    A0EC           ANSWR   A0EE           BREAK   F01E
CI      F003           CILOC   F800           CMD     A0F0
CMDL    A0E9           CMDN    A0E0           CMDW    A0EA
CO      F009           COLOC   F803           CSTS    F012
FLAG    A0E2           FLSTAT  CA4B           IN      A075
IOCHK   F015           IOSET   F018           LO      F00F
MEMCK   F01B           OLDASN  A0E3           OLDIN   A0E6
OLDOUT  A0E4           OUT     A0B5           PO      F00C
RETADR  A0F2           RI      F006           START   F062
.BLNK.  0000:03 X      .DATA.  0000"    X     .PROG.  0000      X
```

LISTING 2

```
                        ;
                        ; CALLED
                        ;
                        ; CALL &A100,FRMPOS,TOPOS
                        ;
                        ; ON INPUT
                        ;
                        ; CASE 1:
                        ; BC=2
                        ; SP->
                        ; FROM LINE POSITION
                        ; TO LINE POSITION
                        ; HL->
                        ; RETURN ADDRESS
                        ;
A100                    .LOC 0A100H
                        ;
                        ; THIS IS THE ENTRY ROUTINE FOR
                        ; PRINTING ONLY A PORTION OF A CONSOLE
                        ; OUTPUT LINE UNDER BASIC.  THE FIRST
                        ; THING WE DO IS DETERMINE, AS BEST WE
                        ; CAN, WHETHER OR NOT THE PARAMETERS
                        ; ARE VALID.  IF B ISN'T ZERO THEN WE
                        ; HAVE A BAD PARAMETER AND QUIT BY
                        ; GOING TO ..OUT.  IF C DOESN'T EQUAL
                        ; TWO WE GO TO ..CK TO SEE IF IT IS
                        ; EQUAL TO ONE.  OTHERWISE WE DROP INTO
                        ; THE MAIN CODE.
                        ;
A100    78      A100:   MOV A,B
A101    B7              ORA A
```

```
A102      C2 A123                JNZ ..OUT
A105      79                     MOV A,C
A106      FE02                   CPI 2
A108      C2 A125                JNZ ..CK
                                 ;
                                 ; HERE WE FOOL BASIC INTO USING OUR OWN
                                 ; CONSOLE OUTPUT ROUTINE 'OUT' INSTEAD
                                 ; OF ZAPPLE'S 'CO' ROUTINE.  FIRST, WE
                                 ; INITIALIZE THE COUNT OF THE CURRENT
                                 ; OUTPUT LINE POSITION, 'CNT', TO ZERO.
                                 ; NEXT WE REPLACE THE JUMP INSTRUCTION
                                 ; INSIDE BASIC TO THE ZAPPLE CONSOLE
                                 ; OUTPUT ROUTINE 'CO' WITH A JMP TO
                                 ; OUR 'OUT' ROUTINE.  THIS LOCATION
                                 ; WITHIN ZAPPLE BASIC IS DOCUMENTED IN
                                 ; THE BASIC USERS MANUAL.  IF ANOTHER
                                 ; VERSION OF BASIC IS USED, SIMPLY
                                 ; MODIFY THE FIRST 3 BYTES OF THE
                                 ; TELETYPE OUTPUT ROUTINE TO JUMP TO
                                 ; 'OUT'.  FINALLY, THE FROM POSITION
                                 ; AND TO POSITION VALUES IN THE STACK
                                 ; ARE RETRIEVED AND STORED IN 'FROM'
                                 ; AND 'TO'.
                                 ;
A10B      97                     SUB A
A10C      32 A165                STA CNT
A10F      DD21 A133              LXI X,OUT
A113      DD22 0310              SIXD BASIC+10H
A117      DDE1                   POP X
A119      DD22 A168              SIXD TO
A11D      DDE1                   POP X
A11F      DD22 A166              SIXD FROM
                                 ;
                                 ; THIS IS THE CODE TO RETURN TO BASIC
                                 ; IT ASSUMES THAT HL STILL POINTS
                                 ; TO THE PLACE IN THE STACK WHERE THE
                                 ; RETURN ADDRESS IN ZAPPLE IS LOCATED.
                                 ;
A123      F9             ..OUT:  SPHL
A124      C9                     RET
                                 ;
                                 ; THIS ROUTINE HANDLES THE CASE WHERE
                                 ; OTHER THAN TWO PARAMETERS ARE BEING
                                 ; PASSED TO A100.  IF THE NUMBER IS NOT
                                 ; ONE THEN WE LEAVE VIA '..OUT' WITHOUT
                                 ; DOING ANYTHING.  IF THE ANSWER IS ONE,

                                 ; THEN WE RESET THE JUMP AT THE BEGIN-
                                 ; ING OF BASIC TO THE ZAPPLE CONSOLE
                                 ; OUTPUT ROUTINE 'CO'.  IF ANOTHER BASIC

                                 ; IS BEING USED, SIMPLY REPLACE THE
                                 ; FIRST 3 BYTES OF THE TELETYPE
                                 ; OUTPUT ROUTINE.
                                 ;
A125      FE01           ..CK:   CPI 1
A127      20FA                   JRNZ ..OUT
A129      DD21 00EC              LXI X,CO
A12D      DD22 0310              SIXD BASIC+10H
A131      18F0                   JMPR ..OUT
                                 ;
                                 ; THIS IS THE NEW CONSOLE OUTPUT ROUTINE

                                 ; USED WHEN ONLY PORTIONS OF OUTPUT
```

```
                                 ; THREE. )
                                 ;
A158      C1             ..OK2:  POP B
A159      C3 00EC                JMP CO
                                 ;
                                 ; THIS ROUTINE IS USED AT THE BEGINNING
                                 ; OF A LINE.  IT SETS THE POSITION
                                 ; POINTER TO ZERO AND THEN GOES UP TO
                                 ; '..OK2' TO PRINT THE CARRIAGE RETURN
                                 ; OR LINEFEED CHARACTER.
                                 ;
A15C      3A A165        ..LINE: LDA CNT
A15F      97                     SUB A
A160      32 A165                STA CNT
A163      18F3                   JMPR ..OK2
                                 ;
                                 ; THIS IS THE LOCATION OF BASIC IN MY
                                 ; SYSTEM
                                 ;
0300                             BASIC = 300H
                                 ;
                                 ; HERE ARE THE PREVIOUSLY DEFINED DATA
                                 ; AREAS.
                                 ;
A165                             CNT:     .BLKB 1
A166                             FROM:    .BLKW 1
A168                             TO:      .BLKW 1
                                 ;
                                 ;
0000                             .END 0
A100     A100            BASIC   0300            CNT      A165
FROM     A166            OUT     A133            TO       A168
.BLNK.   0000:03 X       .DATA.  0000'    X      .PROG.   0000'    X
```

LISTING 3

```
100    '
200    'CHART - PREPARE A FLOWCHART FROM
300    '         USER CONTROL INPUT.
400    'INITIALIZE STRING SPACE, PUNCH
500    'FILE WIDTH, AND PRINTER WIDTH.
600    '     @@@@@@@@@@@@
700    'NOTE THAT ALL TERMINATOR BLOCKS
800    'LABELED IN THE PROGRAM BY A BLANK
900    'COMMENT LINE FOLLOWED BY A COMMENT
1000   'LINE BEGINNING WITH THE LABEL IN
1100   'THE TERMINATOR BLOCK.
1200   '    @@@@@@@@@@@@@
1300   CLEAR 2000
1400   WIDTH #1,255
1500   WIDTH 255
1600   '********
1700   'PRINT ENTIRE PRINT LINE
1800   CALL &A100,0
1900   '********
2000   '
2100   'FNI - THIS SUBROUTINE READS DATA
2200   'LINES UNTIL ANOTHER CONTROL LINE
2300   'IS FOUND.  THE 5 INPUT PARAMETERS
2400   'SPECIFY THE LENGTH OF DATA TO BE
2500   'MOVED FROM THE INPUT LINE TO THE
2600   'FLOWCHART BLOCK.  A ZERO
2700   'IMPLIES NO DATA AND A VALUE
2800   'GREATER THAN 11 IS MADE 11.
```

```
                             ; LINES
                             ; ARE TO BE PRINTED.  THE FIRST THING
                             ; IT DOES IS DETERMINE IF A NEW LINE
                             ; IS BEING OUTPUT BY TESTING IF A
                             ; CARRIAGE RETURN (13) OR LINEFEED
                             ; (10) IS BEING OUTPUT.  IF SO, CONTROL
                             ; IS TRANSFERRED TO THE NEW LINE
                             ; ROUTINE "..LINE".
                             ;
A133    C5           OUT:    PUSH B
A134    79                   MOV A,C
A135    FE0D                 CPI 13
A137    2823                 JRZ ..LINE
A139    FE0A                 CPI 10
A13B    281F                 JRZ ..LINE
                             ;
                             ; WE ARE IN THE MIDDLE OF A LINE, FIRST
                             ; WE UPDATE THE CURRENT LINE POSITION
                             ; COUNTER.  THEN WE TEST IT AGAINST THE
                             ; LOWER BOUND POSITION, "FROM", AND
                             ; GO TO "..OK1" IF ISN'T LESS THAN
                             ; THIS VALUE.
                             ;
A13D    3A A165              LDA CNT
A140    3C                   INR A
A141    32 A165              STA CNT
A144    47                   MOV B,A
A145    3A A166              LDA FROM
A148    B8                   CMP B
A149    2805                 JRZ ..OK1
A14B    3803                 JRC ..OK1
                             ;
                             ; IF "CNT" IS LESS THAN "FROM" THEN WE
                             ; DON'T OUTPUT THE CHARACTER.  WE JUST
                             ; RETURN.
                             ;
A14D    C1          ..OUT:   POP B
A14E    79                   MOV A,C
A14F    C9                   RET
                             ;
                             ; THE CURRENT COUNT WAS HIGH ENOUGH.  IS

                             ; IT ALSO LOW ENOUGH ?  IF IT IS LESS
                             ; THAN OR EQUAL TO THE POSITION IN "TO"
                             ; WE GO TO "..OK2".  OTHERWISE WE GO
                             ; RETURN
                             ; WITHOUT PRINTING THE BYTE.
                             ;
A150    3A A168     ..OK1:   LDA TO
A153    B8                   CMP B
A154    2802                 JRZ ..OK2
A156    38F5                 JRC ..OUT
                             ;
                             ; WE ARE WITHIN THE PORTION OF THE LINE
                             ; TO BE PRINTED.  THEREFORE, LETS GO TO
                             ; THE ZAPPLE CONSOLE OUTPUT ROUTINE.
                             ; IF ANOTHER VERSION OF BASIC IS BEING
                             ; USED, JUST EXECUTE THE FIRST THREE
                             ; BYTES OF THE TELETYPE OUTPUT ROUTINE
                             ; HERE AND JUMP TO THE FOURTH BYTE OF
                             ; THAT ROUTINE BACK IN BASIC ( BUT BE
                             ; CAREFUL OF INSTRUCTION LENGTHS.  THE
                             ; NUMBER OF BYTES MAY BE GREATER THAN
```

```
2900   DEF FNI (A1,A2,A3,A4,A5)
3000   AA(1) = A1: AA(2) = A2: AA(3) = A3:
        AA(4) = A4: AA(5) = A5
3100   FOR II = 1 TO 5
3200   IF AA(II)>11 THEN AA(II) =11
3300   IF AA(II) = 0 GOTO 3800
3400   JJ = (13-AA(II))/2
3500   LINE INPUT #1,C$
3600   IF LEFT$(C$,1)="+" THEN II =5 : GOTO 3800
3700   MID$(L$(II+1),CNT+JJ,AA(II)) = C$
3800   NEXT II
3900   IF LEFT$(C$,1)<>"+" THEN LINE INPUT #1,
        C$:GOTO 3900
4000   FNEND(0)
4100   '
4200   'FNA - DRAW ARROWS IN THE CURRENT
4300   'CELL. IT CALLS A ROUTINE TO DO
4400   'A "RIGHT" AND THEN A ROUTINE TO
4500   'DO A "BOTTOM" CELL.
4600   DEF FNA(PP$)
4700   IF PP$=" " THEN FNRETURN(0)
4800   IF LEFT$(PP$,1)="R" THEN GOSUB 5400
4900   IF LEFT$(PP$,1)="B" THEN GOSUB 7000
5000   FNRETURN 0
5100   '
5200   'RIGHT - THIS ROUTINE DRAWS A
5300   'RIGHT ARROW
5400   MID$(L$(4),CNT+13,5) = "------"
5500   IF PP$ ="R" GOTO 6600
5600   IF RIGHT$(PP$,1)<>"Y"GOTO5900
5700   MID$(L$(3),CNT+15,3)="YES"
5800   GOTO 6100
5900   IF RIGHT$(PP$,1)<>"N" GOTO 6100
6000   MID$(L$(3),CNT+15,2)="NO"
6100   IF MID$(PP$,2,1)<>"O" GOTO 6400
6200   MID$(L$(4),CNT+17,1)=">"
6300   GOTO 6600
6400   IF MID$(PP$,2,1)<>"I" GOTO6600
6500   MID$(L$(4),CNT+13,1)="<"
6600   RETURN
6700   '
6800   'BOTTOM - THIS ROUTINE DRAWS A BOTTOM ARROW
6900   '
7000   MID$(L$(8),CNT+6)="!"
7100   MID$(L$(9),CNT+6)="!"
7200   MID$(L$(10),CNT+6)="!"
7300   IF PP$="B" GOTO 8400
7400   IF RIGHT$(PP$,1)<>"Y"GOTO7700
7500   MID$(L$(9),CNT+7,3)="YES"
7600   GOTO 7900
7700   IF RIGHT$(PP$,1)<>"N" GOTO 7900
7800   MID$(L$(9),CNT+7,2)="NO"
7900   IF MID$(PP$,2,1)<>"O" GOTO 8200
8000   MID$(L$(10),CNT+6,1)="V"
8100   GOTO 8400
8200   IF MID$(PP$,2,1)<>"I" GOTO 8400
8300   MID$(L$(8),CNT+6) ="^"
8400   RETURN
8500   FNEND 0
8600   '
8700   '**************
8800   'FNC - THIS ENTIRE ROUTINE IS USED
8900   'TO SUBMIT MONITOR COMMANDS TO
9000   'THE ZAPPLE MONITOR WHILE STAYING
```

```
9100  'INSIDE THE BASIC PROGRAM. IT
9200  'RETURNS THE VALUE OF THE NUMBER
9300  'FOUND AFTER THE WORD "ERROR" IN
9400  'THE REPLY STRING.  ALL PROGRAMS
9500  'I WRITE, AS WELL AS ALL ERRORS
9600  'IN FDOS RETURN THIS WORD
9700  'FOLLOWED BY AN ERROR NUMBER IF
9800  'SOMETHING GOES WRONG. THE
9900  'SECRET OF THIS ROUTINE LIES IN
10000 'THE PROGRAM "&A000" WHICH PASSES
10100 'THE ZAPPLE COMMANDS IN THE
10200 'STRING 'A$' TO THE MONITOR AND
10300 'PICKS UP THE OUTPUT IN 'R$'
10400 DEF FNC(A$)
10500 IF LEN(R$)>=20 GOTO 10800
10600 R$="                    "
10700 R$=R$+R$
10800 A$=A$+CHR$(13)
10900 CALL &A000,VARADR(A$),VARADR(R$)
11000 A$=LEFT$(A$,LEN(A$)-1)
11100 T1=INSTR(R$,"ERROR")
11200 IF T1=0: THEN T3=0: GOTO 11500
11300 T2=INSTR(R$,CHR$(13),T1)
11400 T3=VAL(MID$(R$,T1+6,T2-T1-6))
11500 FNEND T3
11600 '**********
11700 '
11800 'FNE - THIS ROUTINE PLACES AN
11900 'ERROR MESSAGE ON THE CONSOLE.
12000 'THE FIRST PARAMETER IS THE ERROR
12100 'NUMBER AND THE SECOND ONE IS
12200 'THE MESSAGE.
12300 DEF FNE(E,M$)
12400 E$ = "ERROR"
12500 PRINT USING 12600;E$,E
12600 !'LLLL ###
12700 PRINT M$
12800 FNEND 0
12900 DIM P$(10),L$(10),AA(5)
13000 INPUT "TYPE CREATE OR PRINT";T$
13100 IF LEFT$(T$,1) = "C" GOTO 14000
13200 LINE INPUT "INPUT FILE"; O$
13300 J=FNC("AR=U" + O$)
13400 IF J=0 GOTO 13700
13500 J=FNE(J, "WHEN OPENING FORMATTED FILE")
13600 GOTO 13200
13700 INPUT "NUMBER OF CHART COLUMNS";WID
13800 WID = WID *18+36
13900 GOTO 42000
14000 LINE INPUT "INPUT FILE";I$
14100 LINE INPUT "OUTPUT FILE";O$
14200 '
14300 '****************
14400 ' ALLOCATE THE INPUT FILE:
14500 ' J=0=OK
14600 A$="AR=U"+I$
14700 J=FNC(A$)
14800 '****************
14900 IF J=0 GOTO 15600
15000 J=FNE(J, "BAD INPUT FILE"):GOTO 14000
15100 '
15200 '****************
15300 'ALLOCATE THE OUTPUT FILE:
15400 'J=0= OK
```

```
21700 'TO THE CORRECT ROUTINE TO
21800 'PROCESS A FLOWCHART SYMBOL.
21900 IF P$(1)="PROC" GOTO 23100
22000 IF P$(1)="TEST" GOTO 24400
22100 IF P$(1)="TERM" GOTO 25700
22200 IF P$(1)="NOTE" GOTO 28200
22300 IF P$(1)="HOOK" GOTO 29300
22400 IF P$(1)="NEXT" GOTO 31400
22500 IF P$(1)="LINE" GOTO 33100
22600 IF P$(1)="DONE" GOTO 41900
22700 IF P$(1)="TITL" OR P$(1)
      ="TITLE" GOTO 38200
22800 IF P$(1)="NULL" GOTO 39300
22900 IF P$(1)="TASK" GOTO 39700
23000 J=FNE(98, "FUNNY REQUEST"
      +CHR$(13)+P$(1)):GOTO 39300
23100 '
23200 'PROC - PROCESS A PROCESS BLOCK
23300 MID$(L$(1),CNT+3,10)= "----------+"
23400 MID$(L$(2),CNT,13)="!           !" '11 SPACES IN THIS BLK
23500 MID$(L$(3),CNT,13)="!           !"
23600 MID$(L$(4),CNT,13)="!           !"
23700 MID$(L$(5),CNT,13)="!           !"
23800 MID$(L$(6),CNT,13)="!           !"
23900 MID$(L$(7),CNT+13)=   "+-----------+"
24000 J=FNA(P$(2))
24100 J=FNA(P$(3))
24200 J=FNI(11,11,11,11,11)
24300 GOTO 19200
24400 '
24500 'TEST - PROCESS A TEST BLOCK
24600 MID$(L$(1),CNT+5,3)="/-\"
24700 MID$(L$(2),CNT+2,9)="/-/   \-\"
24800 MID$(L$(3),CNT+1,11)="/         \"
24900 MID$(L$(4),CNT,13)="<           >"
25000 MID$(L$(5),CNT+1,11)="\         /"
25100 MID$(L$(6),CNT+2,9)="\-\ ? /-/"
25200 MID$(L$(7),CNT+5,3)="\-/"
25300 J=FNA(P$(2))
25400 J=FNA(P$(3))
25500 J=FNI(0,9,11,9,0)
25600 GOTO 19200
25700 '
25800 'TERM - PROCESS A TERMINATOR
25900 'BLOCK
26000 I=1
26100 A$=" "
26200 IF LEFT$(P$(2),1)="T" GOTO 27000
26300 I=3
26400 A$=P$(2)
26500 IF LEFT$(P$(2),1)="B" GOTO 27000
26600 I=2
26700 IF P$(2) ="M" GOTO 27000
26800 IF LEFT$(P$(2),1)<>"M" GOTO 27000
26900 MID$(A$,1,1)="R"
27000 MID$(L$(I),CNT+3,8)="--------"
27100 IF LEFT$(P$(2),1)="T" GOTO 27300
27200 MID$(L$(I),CNT+2,1)="-"
27300 MID$(L$(I+1),CNT+1,11)="/         \"
27400 MID$(L$(I+2),CNT,13)="(           )"
27500 MID$(L$(I+3),CNT+1,11)="\         /"
27600 MID$(L$(I+4),CNT+2,9)="---------"
27700 J=FNA(A$)
27800 IF I=1 THEN J=FNI(9,11,9,0,0)
```

```
15500 'J=3= ALREADY EXISTS
15600 A$="AP=U"+O$
15700 J=FNC(A$)
15800 '****************
15900 IF J=0 GOTO 18200
16000 IF J<>3 GOTO 17800
16100 PRINT "WORK FILE EXISTS"
16200 LINE INPUT "REUSE (Y OR N)";A$
16300 IF A$<>"Y" GOTO 17800
16400 '
16500 '****************
16600 'FIRST CLOSE THE OUTPUT FILE BY
16700 'ASSIGNING IT AWAY FROM THE DISK-
16800 'TO THE CASSETTE DOES THE TRICK.
16900 'THEN USE THE MONITOR"K" COMMAND
17000 'AS MODIFIED TO JUMP TO THE FDOS
17100 'RUN COMMAND TO EXECUTE THE
17200 'HOMEBREW DELETE PROGRAM TO
17300 'DELETE THE OUTPUT FILE.
17400 J=FNC("AP=C")
17500 J=FNC("KR DELETE "+O$)
17600 '******************
17700 GOTO 14600
17800 J=FNE(J, "BAD OUTPUT FILE"): GOTO 14000
17900 '
18000 'SETUP THIS IS THE MAIN STARTUP
18100 'ROUTINE FOR CHART.
18200 ON EOF GOTO 41900
18300 QUOTE #1,0
18400 CNT=-17
18500 DWN=ASC("A")
18600 LINE INPUT #1,C$
18700 '
18800 'NEXT CELL-HERE IS THE MAIN LOOP
18900 'FOR CHART. IT IS JUMPED TO FOR
19000 'EACH NEW CELL ON THE OUTPUT
19100 'PAGE
19200 FOR I=1TO10
19300 P$(I)=" "
19400 NEXT I
19500 FOR I=1 TO 10
19600 L$(I)=L$(I)+"                  " '18 BLANKS HERE!
19700 NEXT I
19800 CNT = CNT+18
19900 A$ = CHR$(DWN)+RIGHT$
      (STR$(((CNT-1)/18)+101),2)
20000 MID$(L$(1),CNT,3)=A$
20100 IF LEFT$(C$,1)="+" GOTO 20300
20200 J=FNE(99, "SHOULD BE + CARD"
       + CHR$(13) + C$):STOP
20300 NUM=0
20400 K=1
20500 K=LEN(C$)-K
20600 C$=RIGHT$(C$,K)
20700 J=INSTR(C$,",")
20800 IF J=0 GOTO 21300
20900 K=J
21000 NUM = NUM+1
21100 P$(NUM) = LEFT$(C$,K-1)
21200 GOTO 20500
21300 NUM=NUM+1
21400 P$(NUM)=C$
21500 '
21600 'PROCESS - THIS ROUTINE JUMPS
```

```
27900 IF I=2 THEN J=FNI(0,9,11,9,0)
28000 IF I=3 THEN J=FNI(0,0,9,11,9)
28100 GOTO 19200
28200 '
28300 'NOTE - PROCESS A NOTE BLOCK
28400 MID$(L$(1),CNT+3,10)=" - - - - +"
28500 MID$(L$(7),CNT,13)="+ - - - - - +"
28600 I=6
28700 IF P$(2)="R" THEN I=12:
        MID$(L$(4),CNT+13,5)="- - -"
28800 IF P$(2)="L" THEN I=0:
        MID$'L$(4),CNT-5,5)="- - -"
28900 MID$(L$(3),CNT+I)="!"
29000 MID$(L$(5),CNT+I)="!"
29100 J=FNI(12,12,12,12,12)
29200 GOTO 19200
29300 '
29400 'HOOK - PROCESS A HOOK BLOCK
29500 A$=" "
29600 I=1
29700 J=4
29800 IF LEFT$(P$(2),1)="T" GOTO 30800
29900 I=5
30000 A$=P$(2)
30100 IF LEFT$(P$(2),1)="B" GOTO 30800
30200 I=3
30300 J=0
30400 A$=" "
30500 IF P$(2)="L" GOTO 30800
30600 J=8
30700 A$=P$(2)
30800 MID$(L$(I),CNT+J+1,3)="/-\"
30900 MID$(L$(I+2),CNT+J+1,3)="\-/"
31000 MID$(L$(I+1),CNT+J,5)="!"+P$(3)+"!"
31100 J=FNA(A$)
31200 LINE INPUT #1,C$
31300 GOTO 19200
31400 '
31500 'NEXT - OUTPUT THE 10 LINES
31600 'FORMING THE CURRENT ROW OF
31700 'CELLS AND CLEAR THEM IN
31800 'PREPERATION FOR THE NEXT ROW.
31900 'RESET CNT TO THE BEGINNING OF
32000 'THE ROW AND INCREMENT THE
32100 'ROW NAME.
32200 FOR I=1 TO 10
32300 IF WID<LEN(L$(I)) THEN WID = LEN(L$(I))
32400 PRINT #1, LEFT$(L$(I),LEN(L$(I))-19)
32500 L$(I)=" "
32600 NEXT I
32700 CNT = -17
32800 DWN = DWN+1
32900 LINE INPUT #1,C$
33000 GOTO 19200
33100 '
33200 'LINE - PROCESS A CELL CONTAINING
33300 'A LINE.
33400 A$=LEFT$(P$(2),1)
33500 B$=MID$(P$(2),2,1)
33600 C$=MID$(P$(2),3,2)
33700 IF A$+B$<>"EW" GOTO 34000
33800 MID$(L$(4),CNT,13)="-------------"
33900 GOTO 36200
34000 IF A$+B$<>"NS" GOTO 34900
34100  MID$(L$(1),CNT+6)="!"
```

```
34200  MID$(L$(2),CNT+6)="!"
34300  MID$(L$(3),CNT+6)="!"
34400  MID$(L$(4),CNT+6)="!"
34500  MID$(L$(5),CNT+6)="!"
34600  MID$(L$(6),CNT+6)="!"
34700  MID$(L$(7),CNT+6)="!"
34800 GOTO 36200
34900 I=2
35000 J=3
35100 IF A$="N" THEN I=0
35200 IF A$="S" THEN I=4
35300 IF B$="E" THEN J=6
35400 IF B$="W" THEN J=0
35500 MID$(L$(4),CNT+J,7)="-------"
35600 MID$(L$(I),CNT+6,1)="!"
35700 MID$(L$(I+1),CNT+6,1)="!"
35800 MID$(L$(I+2),CNT+6,1)="!"
35900 MID$(L$(I+3),CNT+6,1)="!"
36000 MID$(L$(4),CNT+6,1)="+"
36100 D$=C$
36200 IF A$="E" OR B$="E" THEN D$="R"+C$
36300 IF A$="S" OR B$="S" THEN D$="B"+C$
36400 J=FNA(D$)
36500 IF A$<>"S" OR B$<>"E" GOTO 37300
36600 C$="R"+C$
36700 IF MID$(C$,2,1)<>"I" GOTO 37000
36800 MID$(C$,2,1)="O"
36900 GOTO 37200
37000 IF MID$(C$,2,1)<>"O" GOTO 37200
37100 MID$(C$,2,1)="I"
37200 J=FNA(C$)
37300 LINE INPUT #1,C$
37400 IF P$(3)<>"N" AND P$(4)<>"N" GOTO 37900
37500  MID$(L$(1),CNT+6,1)="!"
37600  MID$(L$(2),CNT+6,1)="!"
37700  MID$(L$(3),CNT+6,1)="!"
37800  MID$(L$(4),CNT+6,1)="+"
37900 IF P$(3)<>"W" AND P$(4)<>"W" GOTO 19200
38000 MID$(L$(4),CNT,7)="------+"
38100 GOTO 19200
38200 '
38300 'TITLE - PROCESS TITLE INPUT
38400 'LINES
38500 PRINT #1," "
38600 LINE INPUT #1,C$
38700 IF LEFT$(C$,1)<>"+" GOTO 39100
38800 PRINT #1," "
38900 CNT= -17
39000 GOTO 19200
39100 PRINT #1,C$
39200 GOTO 38600
39300 '
39400 'NULL - PROCESS AN EMPTY CELL.
39500 LINE INPUT #1,C$
39600 GOTO 19200
39700 '
39800 'TASK - PROCESS A TASK BLOCK
39900 MID$(L$(1),CNT+3,10)= "-------+-+"
40000 MID$(L$(2),CNT,13)="! !            ! !" 'ONLY 7 BLANKS
40100 MID$(L$(3),CNT,13)="! !            ! !"
40200 MID$(L$(4),CNT,13)="! !            ! !"
40300 MID$(L$(5),CNT,13)="! !            ! !"
40400 MID$(L$(6),CNT,13)="! !            ! !"
40500 MID$(L$(7),CNT+3,10)= "+-+-------+-+"
```

```
40600 J=FNA(P$(2))
40700 J=FNA(P$(3))
40800 J=FN1(7,7,7,7,7)
40900 GOTO 19200
41000 '
41100 'DONE - THE CHART IS FINISHED.
41200 'IT IS NOW TIME TO PRINT IT
41300 '
41400 '****************
41500 'FIRST WE CLOSE THE OUTPUT FILE
41600 'BY ASSIGNING THE PUNCH AWAY
41700 'FROM THE DISK - THE CASSETTE
41800 'WILL DO.
41900 J=FNC("AP=C")
42000 '****************
42100 '
42200 'PRINT - PRINT THE FLOW CHART
42300 PS=13
42400 LINE INPUT "HARD COPY (Y OR N)";P$
42500 IF P$="Y" THEN PS=16
42600 '
42700 '*****************
42800 'SENDING A CONTROL -9 TO MY
42900 'CONSOLE ALTERNATINGLY TURNS THE
43000 'HARDCOPY PRINTER ON AND OFF
43100 PRINT CHR$(PS)
43200 '*****************
43300 '
43400 '*****************
43500 'HERE WE USE THE PARTIAL PRINTER
43600 'CONTROL ROUTINE, '&A100', TO
43700 'PRINT THE REPORT ON A NARROW
43800 'PRINTER.
43900 FOR X=1TO WID -19 STEP 39
44000 CALL &A100,X,X+38
44100 GOSUB 46600
44200 NEXT X
44300 '*****************
44400 '
44500 '*****************
44600 'USE &A100 TO RESET THE PRINTER
44700 'TO PRINT EVERYTHING.
44800 CALL $A100,0
44900 '*****************
45000 '
45100 '*****************
45200 'DEPENDING ON THE VALUE OF 'PS',
45300 'EITHER PRINT A BLANK LINE OR
45400 'TURN THE HARDCOPY DEVICE
45500 'BACK OFF.
45600 PRINT CHR$(PS)
45700 '*****************
45800 END
45900 '
46000 'REPORT - PRINT THE FLOW CHART
46100 'FOR REAL.
46200 '
46300 '******************
46400 'ASSIGN THE READER FILE TO THE
46500 'FORMER OUTPUT FILE.
46600 J=FNC("AR=U"+O$)
46700 '*****************
46800 ON EOF GOTO 47200
46900 LINE INPUT #1,L$(1)
```

```
47000 PRINT L$(1)
47100 GOTO 46900
47200 RETURN
47300 '
47400 '
```

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S1034

A Versatile Memory Test for the TMS9900

By Tom Morris

One of the many necessary pieces of software for a computing system is the memory test. This software, along with other diagnostics, provides the means of locating a faulty component within the computer system.

Memory problems may manifest themselves in many ways. An addressing error may go unnoticed for an extended period of time, and when it finally makes itself known, may be interpreted as a software *bug.* A random bit dropped or added may produce the same results, or produce a program that *crashes* for no apparent reason. These problems may go unnoticed or lived with until too late, when a valuable data file is accidentally destroyed or partially overwritten.

Program flow can be seen in the flowchart (Figure 1). Startup initializes the necessary constants and reads in the range of memory to be placed under test (steps 1-4). Step 5 presets the memory under test to zero. Step 6 is performed for each location tested and allows the program to be interrupted so the operator may regain control of the system without having to do a restart.

Step 7 validates that the location under test is still zero, a failure here would indicate an addressing problem. If an error is encountered, the error reporting subroutine is called and the necessary information is given to the operator (ADDRESS, CONTENTS, and what the location SHOULD BE).

Steps 9-11 perform a walking bit on test, again all errors are reported as they occur. The remainder of the tests are performed in a similar manner by steps 13-16, 17-19 and 20-23.

When all of the specified memory has been tested, the message 'END OF PASS XXXX' is printed on the console signifying the end of a successful test. If, appended to this message is ', TOTAL ERRORS = YYYY', then at some time during the test errors have been encountered. This feature was added to allow a terminal to be taken off-line, and at a later time returned to on-line. This procedure may be used to save paper and still know if any errors occurred during the test sequence.

The object portion of Listing 1 was loaded and executed beginning at location #5000 (# indicates HEX).

The first request is to enter the start and end address of the memory to be placed under test. The program then cycles through all of the tests and announces a pass completion (Listing 2).

In my system, the memory from #6000 to #7FFF can be write protected, this feature was used to test the memory diagnostic.

Lines 6-17 of Listing 2 show the type of error reporting used, as the memory is occasionally placed in a protected state. Finally a 'BREAK' is issued to regain program control. Again a block of memory is tested. This time the terminal is taken off-line for an extended period of time. When it is finally returned to an on-line state, it can be seen that 604 passes without an error have been made.

This program, while being compact, provides a thorough workout of the memory under test and should provide enough clues to pinpoint the more common memory problems.☐

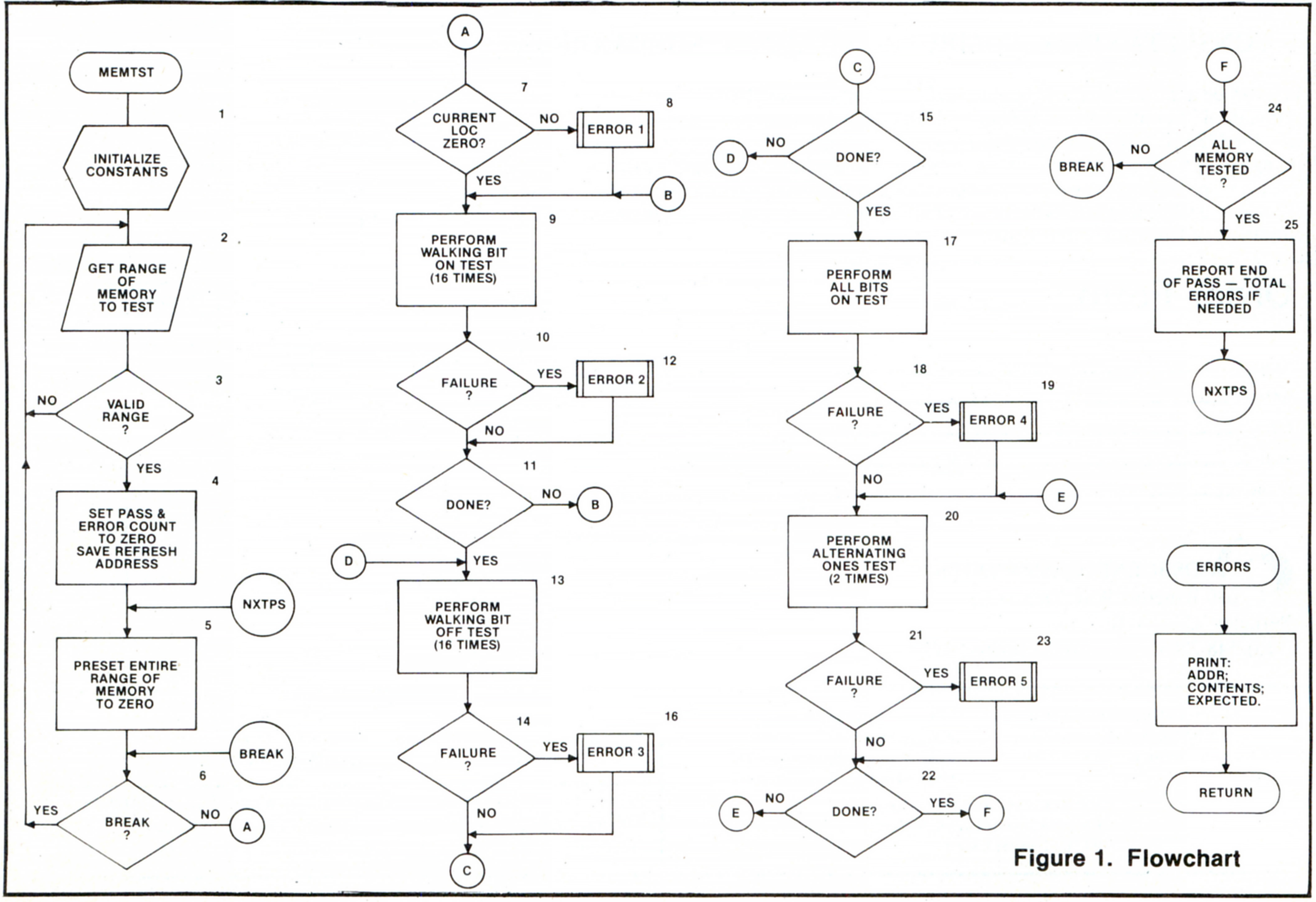
MEMTST
1
INITIALIZE CONSTANTS
2
GET RANGE OF MEMORY TO TEST
3
VALID RANGE ?
NO
YES
4
SET PASS & ERROR COUNT TO ZERO SAVE REFRESH ADDRESS
NXTPS
5
PRESET ENTIRE RANGE OF MEMORY TO ZERO
BREAK
6
BREAK ?
YES
NO
A
A
7
CURRENT LOC ZERO?
NO
8
ERROR 1
YES
B
9
PERFORM WALKING BIT ON TEST (16 TIMES)
10
FAILURE ?
YES
12
ERROR 2
NO
11
DONE?
NO
B
D
YES
13
PERFORM WALKING BIT OFF TEST (16 TIMES)
14
FAILURE ?
YES
16
ERROR 3
NO
C
C
15
DONE?
NO
D
YES
17
PERFORM ALL BITS ON TEST
18
FAILURE ?
YES
19
ERROR 4
NO
E
20
PERFORM ALTERNATING ONES TEST (2 TIMES)
21
FAILURE ?
YES
23
ERROR 5
NO
22
DONE?
NO
E
YES
F
F
24
ALL MEMORY TESTED ?
NO
BREAK
YES
25
REPORT END OF PASS — TOTAL ERRORS IF NEEDED
NXTPS
ERRORS
PRINT: ADDR; CONTENTS; EXPECTED.
RETURN

Figure 1. Flowchart

LISTING 1

```
                      TITL 'MODIFIED COOKS MEMORY TEST FOR THE TMS9900'
0000            MEMIDT IDT
                *
                *   THIS PROGRAM PERFORMS A MODIFIED
                *   VERSION OF COOK'S MEMORY TEST
                *   THIS VERSION WRITTEN BY:
                *       TOM G. MORRIS
                *       861 ST. MARY AVE
                *       SAN LEANDRO, CA 94577
                *
                *   DEFINE THE ENTRY POINT AND REGISTERS
                *
0000                   RORG *
                       DEF   MEMTST,ENDTST
0000                   DREG
                *
                *   DEFINE THE EXTERNAL LINKAGE
                *   TO THE TECHNICO MONITOR (REV. 2)
                *
FE18            RDNUM  EQU   >FE18             ;READ HEX PARAMETERS
FDBA            TYPEWD EQU   >FDBA             ;PRINT R5 AS HEX NUMBER
                *
                *   DEFINE OPERATIONAL EQUIVALENCES
                *
0000            PNTR   EQU   0                 ;SCRATCH POINTER
0001            CA     EQU   1                 ;CURRENT ADDRESS
0002            EA     EQU   2                 ;ENDING ADDRESS
0003            SA     EQU   3                 ;STARTING ADDRESS
0006            PASS   EQU   6                 ;PASS COUNTER
0007            SCR    EQU   7                 ;SCRATCH REGISTER
0008            TEMP   EQU   8                 ;TEMP COMPARISON
0009            ERRS   EQU   9                 ;TOTAL # OF ERRORS
000A            TEN    EQU   10                ;BCD CONVERSION DIVISOR
000C            CRUBAS EQU   12                ;CRU BASE REGISTER
FFFE            WDMSK  EQU   >FFFE             ;WORD BOUNDARY MASK
0000            TTYI   EQU   0                 ;TTY INPUT BIT
0000            MYWS   EQU   0                 ;USE INT. VECTOR LOC. FOR WS
                *
                *   ENTRY TO THE PROGRAM
                *
0000            MEMTST EQU   $
0000 0300 0000         LIMI  0                 ;DISABLE INTERRUPTS
0004 02E0 0000         LWPI  MYWS              ;SET WORKSPACE POINTER
0008 04CC              CLR   CRUBAS            ;PRESET CRU BASE TO ZERO
000A 020A 000A         LI    TEN,TEN           ;PRESET DIVISOR FOR PASS COUNT
000E            RESTRT EQU   $
000E 0200 013E         LI    PNTR,MESS0        ;RESTARTS ARE MADE HERE
0012 06A0 012A         BL    @TYPE             ;PRINT SIGN ON MESSAGE
0016 0205 0004         LI    R5,4              ;READ TWO HEX NUMBERS
001A 06A0 FE18         BL    @RDNUM
001E 0241 FFFE         ANDI  CA,WDMSK          ;FORCE ADDRESSES TO
0022 0242 FFFE         ANDI  EA,WDMSK          ;A WORD BOUNDARY
0026 8081              C     CA,EA             ;VERIFY ADDRESSES
0028 1BF2              JH    RESTRT            ;RESTART IF BAD VALUE
002A 04C6              CLR   PASS              ;SET PASS COUNT TO ZERO
002C 04C9              CLR   ERRS              ;SET ERROR COUNT TO ZERO
002E C0C1              MOV   CA,SA             ;SAVE REFRESH ADDRESS
0030            NXTPS  EQU   $
0030 C043              MOV   SA,CA             ;REFRESH STARTING ADDRESS
0032            CLEAR  EQU   $
0032 04D1              CLR   *CA               ;PRESET MEMORY TO ZERO
0034 05C1              INCT  CA                ;BUMP ADDRESS
0036 1302              JEQ   CLEAR1            ;HANDLE WRAP-AROUND
0038 8081              C     CA,EA             ;TEST FOR ALL OF MEMORY
```

```
003A 12FB              JLE   CLEAR             ;NO, CLEAR SOME MORE
003C            CLEAR1 EQU   $
003C C043              MOV   SA,CA             ;REFRESH THE CURRENT
                                                           ADDRESS
                *
                *   BREAK: CHECK TO SEE IF THE TERMHNAL
                *          BREAK KEY IS DEPRESSED.
                *          IF SO, RESTART THE PROGRAM
                *
003E            BREAK  EQU   $
003E 1F00              TB    TTYI              ;CHECK FOR A BREAK
0040 1303              JEQ   TEST1             ;NO, CONTINUE
0042            BREAK1 EQU   $
0042 1F00              TB    TTYI              ;YES, WAIT FOR IT TO
                                                              END
0044 16FE              JNE   BREAK1
0046 10E3              JMP   RESTRT            ;GO DO A RESTART
                *
                *   TEST1: VERIFIES THAT THE CURRENT
                *          LOCATION IS STILL ZERO
                *          IF IT IS NOT ZERO, THEN
                *          THERE IS MOST LIKELY A
                *          MEMORY ADDRESSING ERROR
                *
0048            TEST1  EQU   $
0048 04C7              CLR   SCR               ;COMPARE AGAINST ZERO
004A C211              MOV   *CA,TEMP          ;GET RESULT
004C 8207              C     SCR,TEMP
004E 1302              JEQ   TEST2
0050 06A0 00D0         BL    @ERROR1           ;REPORT THE ERROR
                *
                *   TEST2: PERFORMS A WALKING
                *          BIT TEST (SINGLE BIT ON)
                *
0054            TEST2  EQU   $
0054 0207 8000         LI    SCR,>8000         ;SET MSB
0058            TEST2A EQU   $
0058 C447              MOV   SCR,*CA           ;STORE THE PATTERN
005A C211              MOV   *CA,TEMP          ;GET IT BACK
005C 8207              C     SCR,TEMP          ;DID IT TAKE ?
005E 1302              JEQ   TEST2B
0060 06A0 00D6         BL    @ERROR2           ;NO, REPORT IT
0064            TEST2B EQU   $
0064 0B17              SRC   SCR,1             ;ROTATE THE PATTERN
0066 17F8              JNC   TEST2A            ;TEST NEXT BIT IF NO
                                                            CARRY
                *
                *   TEST3: PERFORMS A WALKING
                *          BIT TEST (SINGLE BIT OFF)
                *
0068            TEST3  EQU   $
0068 0207 7FFF         LI    SCR,>7FFF         ;ALL BITS BUT MSB
006C            TEST3A EQU   $
006C C447              MOV   SCR,*CA           ;STORE THE PATTERN
006E C211              MOV   *CA,TEMP          ;GET IT BACK
0070 8207              C     SCR,TEMP          ;DID IT TAKE ?
0072 1302              JEQ   TEST3B
0074 06A0 00D6         BL    @ERROR3           ;NO, REPORT IT
0078            TEST3B EQU   $
0078 0B17              SRC   SCR,1             ;GET THE NEW PATTERN
007A 18F8              JOC   TEST3A            ;TEST AGAIN IF CARRY
                *
                *   TEST4: SET ALL BITS TO ONE
                *
007C            TEST4  EQU   $
007C 0707              SETO  SCR               ;SET COMPARE TO ONES
007E C447              MOV   SCR,*CA           ;STORE IT
0080 C211              MOV   *CA,TEMP          ;GET IT BACK
```

```
0082 8207               C     SCR,TEMP          ;ARE THEY THE SAME
0084 1302               JEQ   TEST5             ;YES, CONTINUE
0086 06A0 00DC          BL    @ERROR4           ;NO, REPORT THE ERROR
                 ◆
                 ◆  TEST5: CHECK ALTERNATING ONES PATTERN
                 ◆
008A             TEST5  EQU   $
008A 0207 AAAA          LI    SCR,>AAAA         ;GET PATTERN
008E             TEST5A EQU   $
008E C447               MOV   SCR,◆CA           ;STORE THE PATTERN
0090 C211               MOV   ◆CA,TEMP          ;GET IT BACK
0092 8207               C     SCR,TEMP          ;DO THEY AGREE ?
0094 1302               JEQ   TEST5B
0096 06A0 00E2          BL    @ERROR5           ;NO, REPORT THE ERROR
009A             TEST5B EQU   $
009A 0B17               SRC   SCR,1             ;GET NEW PATTERN
009C 17F8               JNC   TEST5A            ;DONE IF CARRY
                 ◆
                 ◆  AT THIS POINT, INCREMENT THE CURRENT
                 ◆  ADDRESS AND CHECK FOR END OF PASS.
                 ◆  IF SO, ANNOUNCE IT, ELSE TEST NEXT WORD
                 ◆
009E             CONT   EQU   $
009E 05C1               INCT  CA                ;WORD ADDRESSING
00A0 1302               JEQ   ENDPS             ;HANDLE THE WRAP-AROUND CASE
00A2 8081               C     CA,EA             ;TEST FOR END OF PASS
00A4 12CC               JLE   BREAK             ;GO TEST NEXT WORD
00A6             ENDPS  EQU   $
00A6 0586               INC   PASS              ;PASS COMPLETED
00A8 0200 01A7          LI    PNTR,EOP          ;ANNOUNCE IT
00AC 06A0 012A          BL    @TYPE
00B0 C3C6               MOV   PASS,R15          ;GET PASS COUNT
00B2 06A0 0112          BL    @BCD              ;CONVERT PASS TO BCD
00B6 06A0 FDBA          BL    @TYPEWD           ;PRINT NUMBER OF PASSES
00BA C3C9               MOV   ERRS,R15          ;GET NUMBER OF ERRORS
00BC 13B9               JEQ   NXTPS             ;NONE, FORGET IT
00BE 0200 01B4          LI    PNTR,TOTERR       ;GET TOTAL ERRORS PNTR
00C2 06A0 0132          BL    @TYPE2            ;PRINT MSG
00C6 06A0 0112          BL    @BCD              ;CONVERT ERRORS TO BCD
00CA 06A0 FDBA          BL    @TYPEWD           ;PRINT IT
00CE 10B0               JMP   NXTPS
                 ◆
                 ◆  THIS IS THE ERROR REPORTING SECTION.
                 ◆  MULTIPLE ENTRIES ARE;
                 ◆  ERROR1: ALL ZEROES FAILURE
                 ◆  ERROR2: WALKING BIT ON FAILURE
                 ◆  ERROR3: WALKING BIT OFF FAILURE
                 ◆  ERROR4: ALL ONES FAILURE
                 ◆  ERROR5: ALTERNATING ONES FAILURE
                 ◆
00D0             ERROR1 EQU   $
00D0 0200 015A          LI    PNTR,ERR1         ;GET ERROR MSG
00D4 1008               JMP   RETURN            ;JOIN COMMON LOGIC
00D6             ERROR2 EQU   $
00D6             ERROR3 EQU   $
00D6 0200 0168          LI    PNTR,ERR23        ;SAME ERROR MSG FOR BOTH
00DA 1005               JMP   RETURN            ;JOIN COMMON LOGIC
00DC             ERROR4 EQU   $
00DC 0200 0176          LI    PNTR,ERR4
00E0 1002               JMP   RETURN            ;JOIN COMMON LOGIC
00E2             ERROR5 EQU   $
00E2 0200 0184          LI    PNTR,ERR5         ;GET ERR MSG
00E6             RETURN EQU   $
00E6 C34B               MOV   R11,R13           ;SAVE RETURN ADDRESS
00E8 0589               INC   ERRS              ;UPDATE ERROR COUNT
```

```
                    ◆
0168 524F 5441     ERR23  TEXT 'ROTATING AT: '
016C 5449 4E47
0170 2041 543A
0174 20
0175 00                   BYTE 0
                    ◆
0176 414C 4C20     ERR4   TEXT 'ALL ONES AT: '
017A 4F4E 4553
017E 2041 543A
0182 20
0183 00                   BYTE 0
                    ◆
0184 414C 5420     ERR5   TEXT 'ALT ONES AT: '
0188 4F4E 4553
018C 2041 543A
0190 20
0191 00                   BYTE 0
                    ◆
0192 2C20 4953     IS     TEXT ', IS: '
0196 3A20
0198 00                   BYTE 0
                    ◆
0199 2C20 5348     SB     TEXT ', SHOULD BE: '
019D 4F55 4C44
01A1 2042 453A
01A5 20
01A6 00                   BYTE 0
                    ◆
01A7 454E 4420     EOP    TEXT 'END OF PASS '
01AB 4F46 2050
01AF 4153 5320
01B3 00                   BYTE 0
                    ◆
01B4 2C20 544F     TOTERR TEXT ', TOTAL ERRORS = '
01B8 5441 4C20
01BC 4552 524F
01C0 5253 203D
01C4 20
01C5 00                   BYTE 0
                    ◆
01C6 0D            RET    BYTE >0D                 ;RETURN
01C7 0A            LINF   BYTE >0A                 ;LINE FEED
                    ◆
01C7               ENDTST EQU  $-1
01C8                      END

 0112 BCD      003E BREAK    0042 BREAK1   0001 CA       0032 CLEAR
 003C CLEAR1  ◆009E CONT     000C CRUBAS   0002 EA       00A6 ENDPS
 013C ENDT    ◆01C7 ENDTST   01A7 EOP      015A ERR1     0168 ERR23
 0176 ERR4     0184 ERR5     00D0 ERROR1   00D6 ERROR2   00D6 ERROR3
 00DC ERROR4   00E2 ERROR5   0009 ERRS     0192 IS       01C7 LINF
◆0000 MEMIDT  ◆0000 MEMTST   013E MESS0    0000 MYWS     0118 NEXTD
 0030 NXTPS    0006 PASS     0000 PNTR    ◆0000 R0      ◆0001 R1
◆000A R10      000B R11     ◆000C R12      000D R13      000E R14
 000F R15     ◆0002 R2      ◆0003 R3       0004 R4       0005 R5
◆0006 R6      ◆0007 R7      ◆0008 R8      ◆0009 R9       FE18 RDNUM
 000E RESTRT   01C6 RET      00E6 RETURN   0003 SA       0199 SB
 0007 SCR      0008 TEMP     000A TEN      0048 TEST1    0054 TEST2
 0058 TEST2A   0064 TEST2B  ◆0068 TEST3    006C TEST3A   0078 TEST3B
◆007C TEST4    008A TEST5    008E TEST5A   009A TEST5B   01B4 TOTERR
 0000 TTYI     012A TYPE     0132 TYPE2    FDBA TYPEWD   FFFE WDMSK
```

```
00EA 06A0 012A          BL    @TYPE                ;PRINT ERROR MSG
00EE C141               MOV   CA,R5                ;PRINT ADDRESS OF ERROR
00F0 06A0 FDBA          BL    @TYPEWD
00F4 0200 0192          LI    PNTR,IS              ;PRINT WHAT IT IS
00F8 06A0 0132          BL    @TYPE2
00FC C148               MOV   TEMP,R5
00FE 06A0 FDBA          BL    @TYPEWD
0102 0200 0199          LI    PNTR,SB              ;PRINT WHAT IT SHOULD BE
0106 06A0 0132          BL    @TYPE2
010A C147               MOV   SCR,R5
010C 06A0 FDBA          BL    @TYPEWD
0110 045D               B     ◆R13                 ;RETURN TO CALLER
                ◆
                ◆  CONVERT THE BINARY VALUE IN R15
                ◆  TO A BCD VALUE IN R5
                ◆
0112            BCD     EQU   $
0112 04C5               CLR   R5                   ;CLEAR SUM
0114 0204 0004          LI    R4,4                 ;NUMBER OF DIGITS
0118            NEXTD   EQU   $
0118 04CE               CLR   R14                  ;CLEAR MSWD
011A 3F8A               DIV   TEN,R14              ;DIVIDE R14,15 BY TEN
011C 0945               SRL   R5,4                 ;MAKE ROOM FOR DIGIT
011E 0ACF               SLA   R15,12               ;POSITION NEW DIGIT
0120 A14F               A     R15,R5               ;ADD IN DIGIT
0122 C3CE               MOV   R14,R15              ;GET NEW DIVIDEND
0124 0604               DEC   R4                   ;CHECK FOR FOUR DIGITS
0126 16F8               JNE   NEXTD                ;NO, DO NEXT DIGIT
0128 045B               B     ◆R11                 ;RETURN
                ◆
                ◆  TYPE: PRINT THE STRING POINTED
                ◆        TO BY (PNTR) ON A NEW LINE.
                ◆        TERMINATE ON NULL
                ◆
                ◆  TYPE2: DON'T ISSUE A NEW LINE
                ◆
012A            TYPE    EQU   $
012A 2CA0 01C6          OUT   @RET                 ;ISSUE NEW LINE
012E 2CA0 01C7          OUT   @LINF
0132            TYPE2   EQU   $
0132 D410               MOVB ◆PNTR,◆PNTR           ;TEST FOR NULL
0134 1303               JEQ   ENDT
0136 2C90               OUT   ◆PNTR                ;NO, PRINT THE CHAR
0138 0580               INC   PNTR                 ;UPDATE POINTER
013A 10FB               JMP   TYPE2                ;PRINT NEXT CHAR
013C            ENDT    EQU   $
013C 045B               B     ◆R11                 ;RETURN TO CALLER
                ◆
                ◆  STRING STORAGE AREA
                ◆
013E 5354 4152  MESS0   TEXT 'START,END ADDRESS TO TEST ?'
0142 542C 454E
0146 4420 4144
014A 4452 4553
014E 5320 544F
0152 2054 4553
0156 5420 3F
0159 00                 BYTE 0
                ◆
015A 4E4F 4E2D  ERR1    TEXT 'NON-ZERO AT: '
015E 5A45 524F
0162 2041 543A   .
0166 20
0167 00                 BYTE 0
```

```
OUTPUT READY?
00000MEMIDT
          H0000A0000B0300B0000B02E0B0000B04CCB020AB000AB0200C013E7F141F
B06A0C012AB0205B0004B06A0BFE18B0241BFFFEB0242BFFFEB8081B1BF2B04C67F117F
B04C9BC0C1BC043B04D1B05C1B1302B8081B12FBBC043B1F00B1303B1F00B16FE7F159F
B10E3B04C7BC211B8207B1302B06A0C00D0B0207B8000BC447BC211B8207B13027F1BDF
B06A0C00D6B0B17B17F8B0207B7FFFBC447BC211B8207B1302B06A0C00D6B0B177F14FF
B18F8B0707BC447BC211B8207B1302B06A0C00DCB0207BAAAABC447BC211B82077F154F
B1302B06A0C00E2B0B17B17F8B05C1B1302B8081B12CCB0586B0200C01A7B06A07F19BF
C012ABC3C6B06A0C0112B06A0BFDBABC3C9B13B9B0200C01B4B06A0C0132B06A07F14BF
C0112B06A0BFDBAB10B0B0200C015AB1008B0200C0168B1005B0200C0176B10027F1E4F
B0200C0184BC34BB0589B06A0C012ABC141B06A0BFDBAB0200C0192B06A0C01327F187F
BC148B06A0BFDBAB0200C0199B06A0C0132BC147B06A0BFDBAB045DB04C5B02047F135F
B0004B04CEB3F8AB0945B0ACFBA14FBC3CEB0604B16F8B045BB2CA0C01C6B2CA07F0E6F
C01C7BD410B1303B2C90B0580B10FBB045BB5354B4152B542CB454EB4420B41447F190F
B4452B4553B5320B544FB2054B4553B5420B3F00B4E4FB4E2DB5A45B524FB20417F179F
B543AB2000B524FB5441B5449B4E47B2041B543AB2000B414CB4C20B4F4EB45537F188F
B2041B543AB2000B414CB5420B4F4EB4553B2041B543AB2000B2C20B4953B3A207F1B6F
B002CB2053B484FB554CB4420B4245B3A20B0045B4E44B204FB4620B5041B53537F1AEF
B2000B2C20B544FB5441B4C20B4552B524FB5253B203DB2000B0D0A501C7ENDTST7F0EEF
50000MEMTST001C8            7FAEEF
:

EDIT/ASM/LOAD?
```

LISTING 2

```
?G5000

START,END ADDRESS TO TEST ?5700,7FFE
END OF PASS 0001
END OF PASS 0002
END OF PASS 0003
END OF PASS 0004
ROTATING AT: 6BF2, IS: BFFF, SHOULD BE: DFFF
END OF PASS 0005, TOTAL ERRORS = 0001
ROTATING AT: 6B24, IS: 1000, SHOULD BE: 0800
ROTATING AT: 6E66, IS: DFFF, SHOULD BE: EFFF
ROTATING AT: 70A4, IS: 0040, SHOULD BE: 0020
ROTATING AT: 735E, IS: 1000, SHOULD BE: 0800
ROTATING AT: 763A, IS: 0400, SHOULD BE: 0200
ROTATING AT: 7FDA, IS: 0004, SHOULD BE: 0002
END OF PASS 0006, TOTAL ERRORS = 0007
END OF PASS 0007, TOTAL ERRORS = 0007
END OF PASS 0008, TOTAL ERRORS = 0007
END OF PASS 0009, TOTAL ERRORS = 0007
END OF PASS 0010, TOTAL ERRORS = 0007
START,END ADDRESS TO TEST ?4000,4FFE
END OF PASS 0001
END OF PASS 0002
END OF PASS 0003
END OF PASS 0004
END OF PASS 0005
END OF PASS 0006
END OF PASS 0007
END OF PASS 0008
END OF PASS 0612
END OF PASS 0613
END OF PASS 0614
START,END ADDRESS TO TEST ?
?
```

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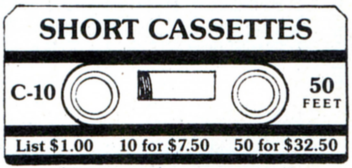

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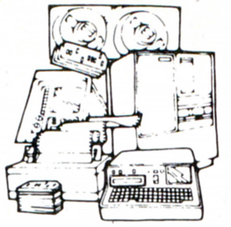

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FIFO Flea Market has been provided as a free service to INTERFACE AGE readers and was printed as space permitted. This is the last month the magazine will be able to provide this service. We hope that all who participated were able to benefit.

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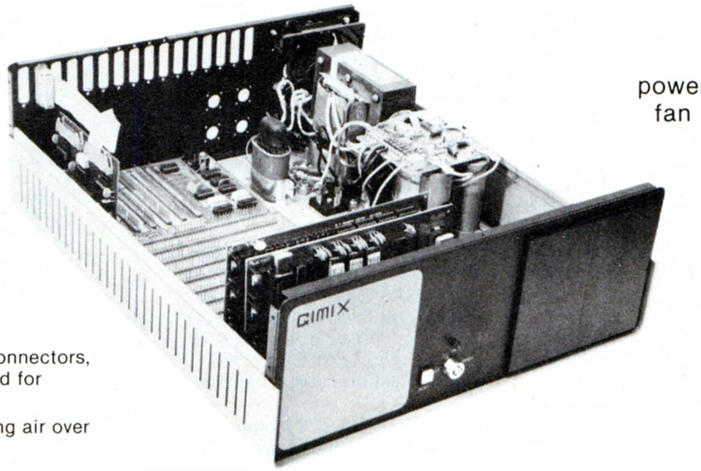

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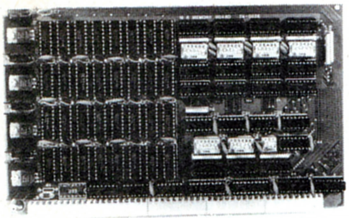

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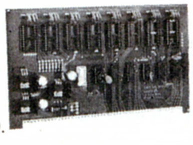

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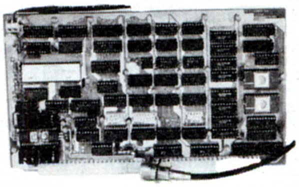

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243 ☐ Hardware 244 ☐ Software 245 ☐ Peripherals 246 ☐ Components

ANSWER THE FOLLOWING BY CHECKING ONLY ONE BOX PER QUESTION

1. My Field is:
A. ☐Professional (Medical, Accounting, Law, Etc.)
B. ☐Engineer (Mechanical, Electrical, Etc.)
C. ☐Business (Retail, Wholesale, Etc.)
D. ☐Educational (Professor, Teacher, Assistant, Etc.)
E. ☐Government (Armed Services, State, Federal, Etc.)
F. ☐Consumer (Hobbyist, Etc.)
G. ☐Other

2. My Position/Title is:
A. ☐Owner/President
B. ☐Executive Officer
C. ☐Division/Department Manager
D. ☐Supervisor
E. ☐General Staff Member
F. ☐Consultant
G. ☐Other

3. I Need This Information for:
A. ☐Immediate purchase
B. ☐Purchase 30-60 days
C. ☐Comparisons
D. ☐Literature Library
E. ☐Other

4. My Application is:
A. ☐Business Only
B. ☐Business and Personal
C. ☐Personal Only
D. ☐Instructional
E. ☐Research and Development
F. ☐OEM
G. ☐Other

5. My Interest Emphasis is:
A. ☐Hardware
B. ☐Firmware
C. ☐Software
D. ☐Other

6. My Professional Interest is:
A. ☐Accounting System
B. ☐Inventory Control System
C. ☐Process Control System
D. ☐Medical Research
E. ☐Educational System
G. ☐Other

7. My Personal Interest is:
A. ☐Games
B. ☐Home Economics
C. ☐Computer Art and Graphics
D. ☐Personal Investments
E. ☐Child Educational Development
F. ☐Sports
G. ☐Other

8. My Budget for a Computer System is:
A. ☐$ 0 - $ 1,999
B. ☐$ 2,000 - $ 4,999
C. ☐$ 5,000 - $ 9,999
D. ☐$10,000 - $20,000
E. ☐Over $20,000

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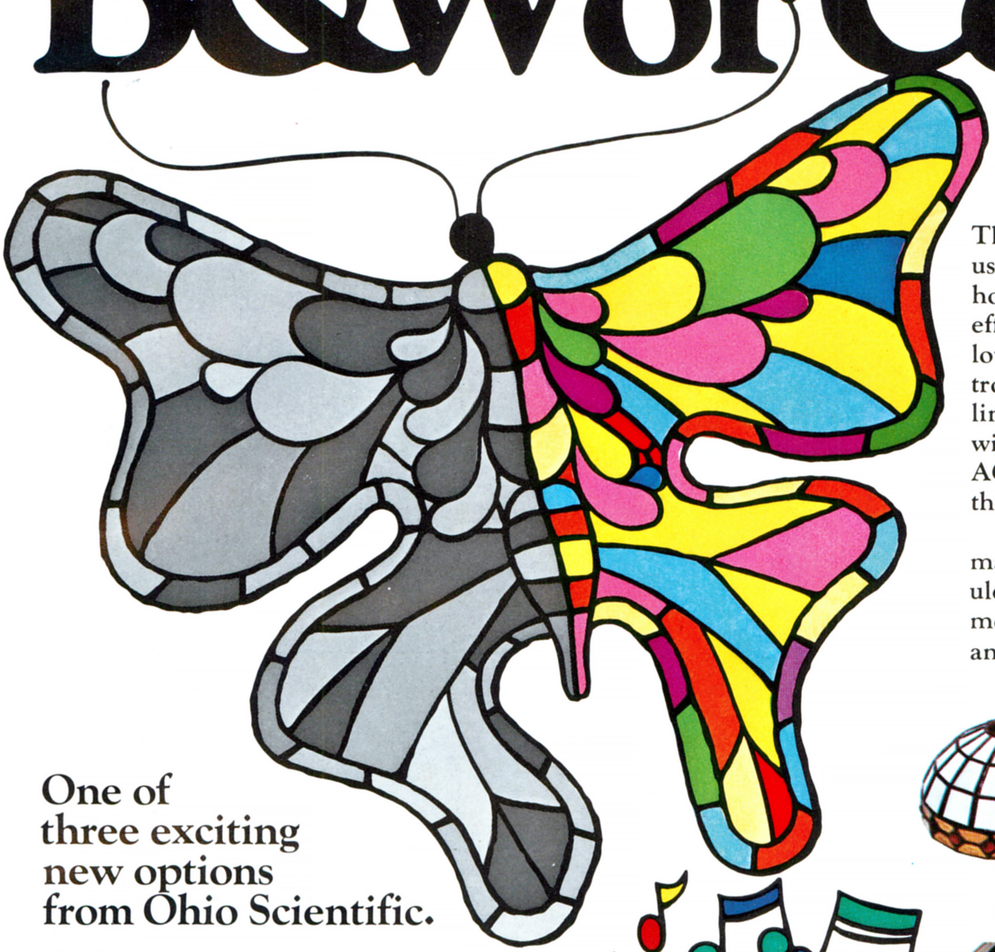

One of three exciting new options from Ohio Scientific.

Color. With it there is a big difference. And now, Ohio Scientific offers a lustrous 16 color option on all its C2 Series Computer Systems, past and present. New orders for C2-4P and C2-8P's can now request the color option. Upgrade kits are available for all existing C2's. When coupled with the C2's demonstrated high resolution graphics, the new color display is striking.

The relatively easy add-on of color and other options discussed here are interfaced through the new 540 B video board and are realized without extensive modification or excessive cost because the C2 family of computers feature exceptional "design for the future" modular construction that permits one sector of the computer to be modified without affecting other sectors.

Sound. The sound option further enhances enjoyment of the C2's while broadening their scope of applications. Games of logic and dexterity now seem to come alive when sound pops out from on-screen happenings.

This new option is implemented through the new 542 Rev B keyboard available with new C2 orders or as part of an upgrade kit. In addition to a standard tone generator, this new board also contains a D/A (digital to analog) converter that takes advantage of the power and ultra high speed of the C2's 6502 microprocessor to enable users to generate both limited band-width speech and complex musical chords.

AC-12 Remote AC Control System.

This unique option enables a C2 user to create a computerized wireless home control facility with simple effort and at heretofore unheard of low cost. The AC-12 provides a control signal on the home's AC power line not unlike the manner in which wireless intercoms function. The AC-12 will plug into any C2 computer that has the new 540 B video board.

The basic system contains a command console and four remote modules. The remotes can be appliance modules that can switch up to 15 amps, lamp modules that can provide on-off, dimming and brightening, or wall switch modules.

The AC-12 has a special Home Control OS-65D V 3.0 Mini-Floppy Disk Operating System that provides a wide range of capabilities not the least of which is "Foreground and Background" operation. This allows the computer to monitor time and inputs for the Home Control System, while running other BASIC programs!

New options:

Color and Sound Option on C2-4P and C2-8P	Add $200
CA-11B 540B color video board for system upgrades (does not include 542B sound keyboard)	$225
CA-11C 540B color video board and 542B sound keyboard. (For upgrades)	$299
AC-12 Remote AC control system, including console, four remotes and software. For use on any system with a 540B video board	$175

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